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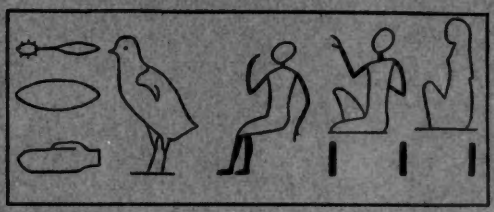
CHILD DEVELOPMENT



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INTERPOLATION FORMULAE FOR THE GROWTH OF THE HUMAN BRAIN AND ITS MAJOR PARTS IN THE FIRST YEAR OF POSTNATAL LIFE

RICHARD E. SCAMMON [1]

The general course of the growth curve of the mass of the human brain in postnatal life is fairly well known.

The total brain increases in weight very rapidly after birth through infancy and the early part of childhood, and grows relatively little thereafter. The same observations hold true for the several major parts of the encephalon, although each shows a slightly different fashion of growth than that of the brain as a whole.

Descriptive curves of brain growth from birth to maturity may be represented by a number of expressions, some quite elaborate and some fairly simple. However the brain as a whole and its several major parts increase so rapidly in the first year that straight line expressions for the relationship between masses of these structures and time seem justifiable for practical use in this period. Such straight lines are, in effect, secants of the very abrupt early segments of brain-growth curves that cover the entire postnatal growth period.

It should be pointed out that while these straight line expressions may be safely used for interpolation, they should not be extrapolated to represent the later growth of the brain and that rates and ratios obtained from them are approximate at best.

There are available in this laboratory nearly 1300 records of the observations on the mass of the total brain or encephalon in the first year and nearly 1260 records of the weights of the major brain parts, cerebrum, cerebellum and brain stem. Some of these are in the form of averages but a number are of individual cases. As is the case with practically all records of organ weights, these are drawn largely from a hospital population, although all records indicating any involvement of the brain in disease have been eliminated. Only Caucasian brains are included. Simple empirical formulae have been developed by the method of averages (the points included being birth, first quarter, second quarter and second half of the first year). The results obtained are as follows:

TOTAL BRAIN (ENCEPHALON)

The formulae and graphs for the growth of the total brain (males, females and both sexes) are shown in Figure 1. Table 1 shows the observed and calculated values at birth, for each month and for each quarter. In both the graph and the table it has been assumed (as is necessary because of the grouping of the cases) that the median points of the respective months and quarters represent the average or mean age of the individuals in the group. The first segment of Table 5 shows the

[1] From the Graduate School and the Institute of Child Welfare, University of Minnesota

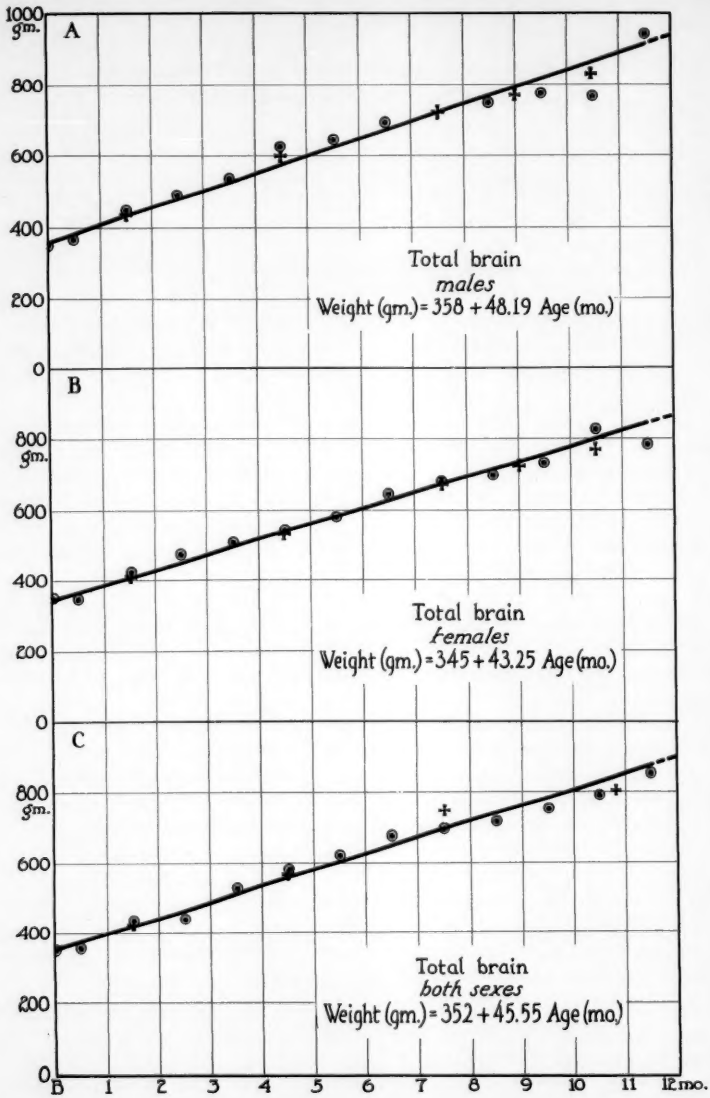

Figure 1. Graphs showing the monthly and quarterly averages of weight of the total brain (encephalon) in the first year of postnatal life. A, males; B, females; C, both sexes. Mean values at birth and for each monthly interval indicated by circled dots. Mean values for quarters (and for the second half-year) indicated by crosses. Lines of central tendency (as represented by the empirical formulae in the panels of the graph) drawn in solid line.

TABLE 1

OBSERVED AND CALCULATED WEIGHT OF THE TOTAL BRAIN
IN THE FIRST YEAR OF POSTNATAL LIFE

Age Range	Males			Females			Both Sexes		
	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)
Birth	137	352.8	358.0	122	346.7	345.0	317	350.7	352.0
Months									
First	117	369.2	382.1	110	350.0	366.6	227	359.9	374.8
Second	69	447.7	430.3	61	423.7	409.9	130	436.4	420.3
Third	82	488.2	478.5	57	471.3	453.1	139	481.2	465.9
Fourth	53	537.7	526.7	50	506.4	496.4	104	523.1	511.4
Fifth	34	625.1	574.9	38	541.0	539.6	72	580.7	557.0
Sixth	41	647.7	623.0	31	584.1	582.9	73	620.6	602.5
Seventh	23	695.4	671.2	24	644.6	626.1	48	670.2	648.1
Eighth	22	714.2	719.4	18	675.3	669.4	41	698.2	693.6
Ninth	17	750.1	767.6	24	696.5	712.6	41	718.7	739.2
Tenth	13	774.2	815.8	17	732.5	755.9	30	750.6	784.7
Eleventh	14	763.9	864.0	13	824.5	799.1	27	793.1	830.3
Twelfth	15	936.8	912.2	17	783.6	842.4	32	855.4	875.8
Quarters									
First	272	435.0	430.3	237	410.5	409.9	535	420.5	420.3
Second	149	599.8	574.9	150	534.3	539.6	299	567.0	557.0
Third	62	715.0	719.4	66	671.8	669.4	130	694.3	693.6
Fourth	42	828.8	864.0	47	776.4	799.1	89	801.2	830.3
Third and Fourth	174	770.0	791.7	167	726.5	734.2	342	748.4	762.0

(All weights calculated to the second and thrown to the first decimal.)

mean residuals (observed minus computed values), absolute and relative, weighted and unweighted by the number of observations, for each of these expressions. As a whole the expressions fit quite well, that for the male brains being the least and that for the female brains being the most satisfactory by all the tests tried.

CEREBRUM (CEREBRAL HEMISPHERES PLUS THE THALAMENCEPHALON)

The graphics of the relation of cerebrum weight to age and the empirical formulae therefor are shown in Figure 2. Table 2 shows the observed and computed values. Inspection of the graph shows that the fits are moderately good, as is indicated also by the measures given in the second division of Table 5. The fit

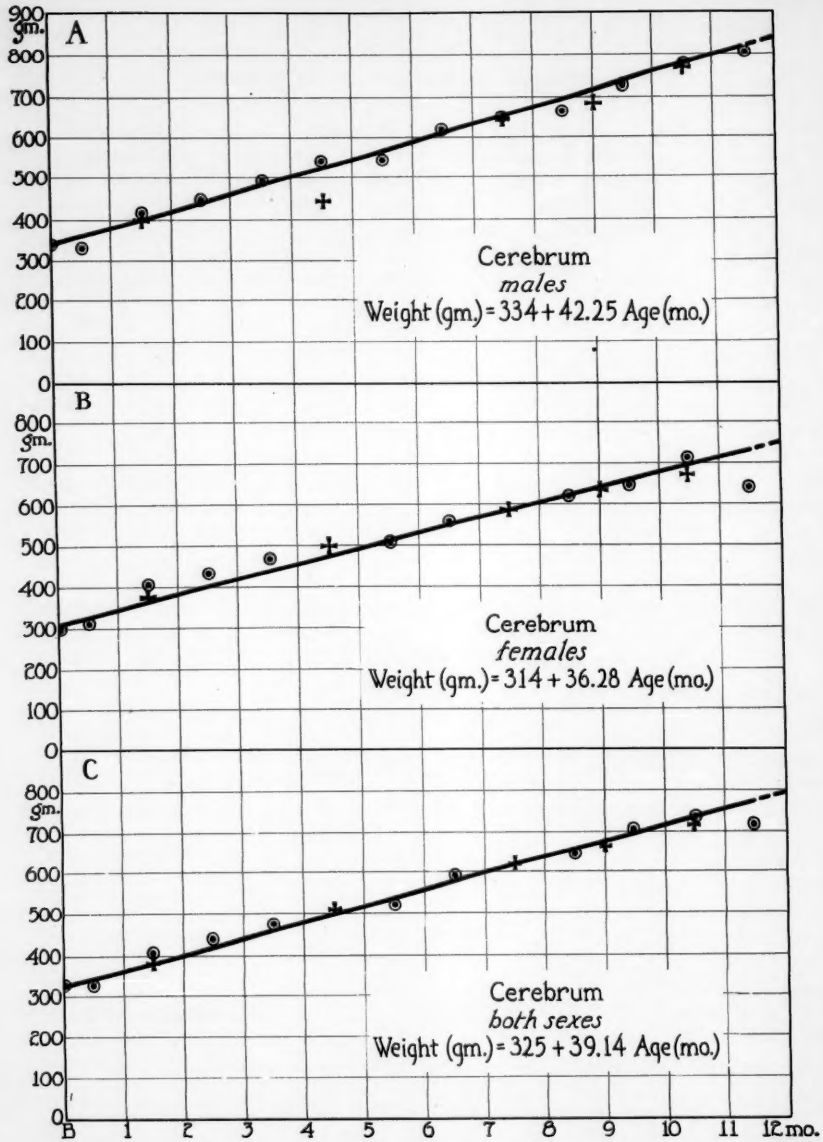

Figure 2. Graphs showing the monthly and quarterly averages of weight of the cerebrum (cerebral hemispheres and thalamencephalon) in the first year of postnatal life. A, males; B, females; C, both sexes. Symbols as in Figure 1.

TABLE 2

OBSERVED AND CALCULATED WEIGHT OF THE CEREBRUM
IN THE FIRST YEAR OF POSTNATAL LIFE

Age Range	Males			Females			Both Sexes		
	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)
Birth	63	337.4	334.0	45	300.2	314.0	108	321.9	325.0
Months									
First	53	332.2	355.1	48	311.7	332.1	101	322.5	344.6
Second	25	415.8	397.4	27	402.8	368.4	52	409.1	383.7
Third	27	449.4	439.6	26	435.6	404.7	53	442.6	422.8
Fourth	12	494.4	481.9	18	466.2	441.0	30	477.5	462.0
Fifth	10	540.2	524.1	13	474.1	477.3	23	502.8	501.1
Sixth	11	544.1	566.4	14	503.9	513.5	25	521.6	540.3
Seventh	9	618.2	608.6	6	556.5	549.8	15	593.5	579.4
Eighth	9	648.9	650.9	5	585.2	586.1	14	626.1	618.6
Ninth	6	668.0	693.1	4	619.5	622.4	10	648.6	657.7
Tenth	4	729.2	735.4	2	647.5	658.6	6	702.0	696.8
Eleventh	2	778.0	777.6	4	713.2	694.9	6	734.8	736.0
Twelfth	4	804.8	819.9	5	644.0	731.2	9	715.4	775.1
Quarters									
First	120	391.8	397.4	120	376.2	368.4	240	384.0	383.7
Second	47	537.4	524.1	68	490.8	477.3	115	509.9	501.1
Third	24	642.2	650.9	15	582.9	586.1	39	619.4	618.6
Fourth	10	769.2	777.6	11	669.8	694.9	21	717.1	736.0
Third and Fourth	80	684.8	714.2	64	633.5	640.5	144	662.0	677.3

(All weights calculated to the second and thrown to the first decimal.)

for cerebrum weight for both sexes when taken by quarters is decidedly better than that for either males or females.

CEREBELLUM

Figure 3 shows the observed means and the calculated trends of cerebellum weight in males, females and both sexes combined. While the observed values depart somewhat from the calculated ones, there is little evidence of any consistent trend in the differences except that the computed values in the last two months seem somewhat high. The fit of the expression for cerebellum weight for both sexes is slightly better by most of the tests employed than are the fits for either male or female cerebellum weight.

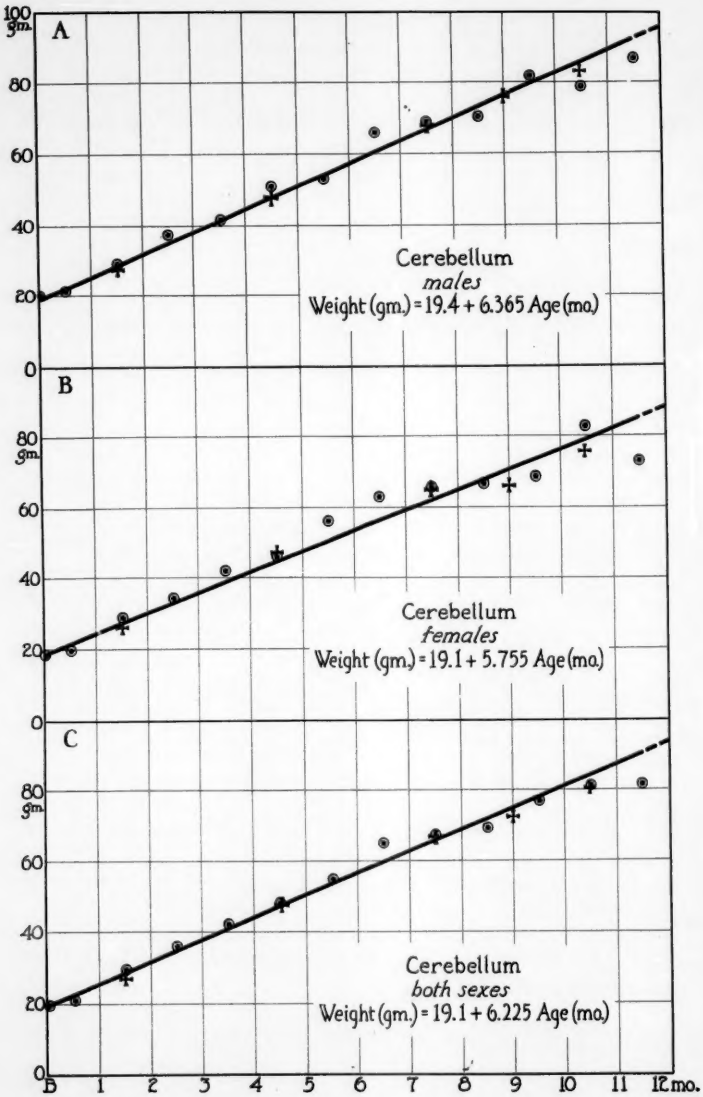

Figure 3. Graphs showing the monthly and quarterly averages of weight of the cerebellum in the first year of postnatal life. A, males; B, females; C, both sexes. Symbols as in Figure 1.

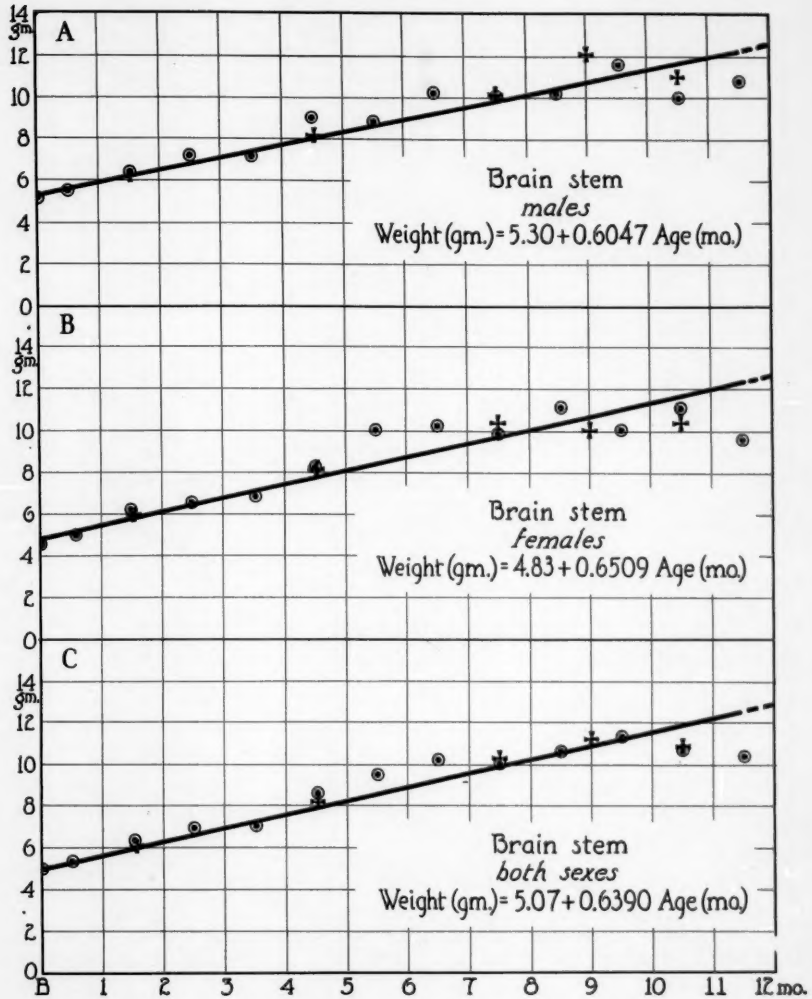
A
Brain stem
males
Weight (gm.) = 5.30 + 0.6047 Age (mo.)
B
Brain stem
females
Weight (gm.) = 4.83 + 0.6509 Age (mo.)
C
Brain stem
both sexes
Weight (gm.) = 5.07 + 0.6390 Age (mo.)
gm.
0 2 4 6 8 10 12 14
B 1 2 3 4 5 6 7 8 9 10 11 12 mo.

Figure 4. Graphs showing the monthly and quarterly averages of weight of the brain stem (pons, medulla and midbrain) in the first year of postnatal life. A, males; B, females; C, both sexes. Symbols as in Figure 1.

TABLE 3

OBSERVED AND CALCULATED WEIGHT OF THE CEREBELLUM
IN THE FIRST YEAR OF POSTNATAL LIFE

Age Range	Males			Females			Both Sexes		
	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)
Birth	58	20.2	19.4	41	19.4	19.1	99	19.8	19.1
Months									
First	45	21.4	22.6	43	20.0	22.0	88	20.7	22.2
Second	25	29.2	29.0	26	29.3	27.7	51	29.3	28.4
Third	25	37.5	35.3	24	34.5	33.5	49	36.0	34.7
Fourth	11	41.7	41.7	16	42.4	39.2	27	42.1	40.9
Fifth	8	51.1	48.0	12	46.7	45.0	20	48.5	47.1
Sixth	8	53.9	54.4	10	56.3	50.8	18	55.2	53.3
Seventh	8	66.2	60.8	5	63.4	56.5	13	65.2	59.6
Eighth	6	69.0	67.1	5	65.8	62.3	11	67.5	65.8
Ninth	6	71.0	73.5	3	67.0	68.0	9	69.7	72.0
Tenth	4	82.2	79.9	1	59.0	73.8	5	77.6	78.2
Eleventh	2	79.0	86.2	3	83.3	79.5	5	81.6	84.5
Twelfth	4	87.2	92.6	2	73.5	85.3	6	82.7	90.7
Quarters									
First	110	28.1	29.0	111	26.2	27.7	221	27.1	28.4
Second	41	48.3	48.0	59	47.6	45.0	100	47.9	47.1
Third	20	68.5	67.1	13	65.2	62.3	33	67.2	65.8
Fourth	10	83.6	86.2	6	76.0	79.5	16	80.8	84.5
Third and Fourth	76	76.0	76.7	57	66.7	70.9	133	72.7	75.1

(All weights calculated to the second and thrown to the first decimal.)

BRAIN STEM (PONS, MEDULLA AND MIDBRAIN)

As might be expected, there is slightly more error in the fits of the expressions for this part of the brain than for the others. The methods of deliminating the boundaries of the brain stem are less accurate and differ more between observers. But in addition to this experimental error, there also seems to be some change in trend with a tendency for the observed weights in the later months to increase less rapidly than the calculated values. This is seen both in Figure 4 and in Table 4. As a whole the correlation between observed and calculated values is better for the brain stem weight for both sexes and for males than for females.

TABLE 4

OBSERVED AND CALCULATED WEIGHT OF THE BRAIN STEM
IN THE FIRST YEAR OF POSTNATAL LIFE

Age Range	Males			Females			Both Sexes		
	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)	N	Observed Weight (gm.)	Calculated Weight (gm.)
Birth	58	5.2	5.3	41	4.5	4.8	99	4.9	5.1
Months									
First	45	5.5	5.6	43	5.1	5.2	88	5.3	5.4
Second	25	6.4	6.2	26	6.2	5.8	51	6.3	6.0
Third	25	7.2	6.8	24	6.6	6.5	49	6.9	6.7
Fourth	11	7.2	7.4	16	6.8	7.1	27	7.0	7.3
Fifth	8	9.0	8.0	12	8.2	7.8	20	8.6	8.0
Sixth	8	8.8	8.6	10	10.0	8.4	18	9.5	8.6
Seventh	8	10.2	9.2	5	10.2	9.1	13	10.2	9.2
Eighth	6	10.1	9.8	5	9.9	9.7	11	10.0	9.9
Ninth	6	10.2	10.4	4	11.1	10.4	10	10.6	10.5
Tenth	4	11.6	11.0	1	10.0	11.0	5	11.3	11.1
Eleventh	2	10.0	11.7	3	11.1	11.7	5	10.7	11.8
Twelfth	4	10.8	12.3	2	9.6	12.3	6	10.4	12.4
Quarters									
First	110	6.3	6.2	111	6.0	5.8	221	6.1	6.0
Second	41	8.2	8.0	59	8.2	7.8	100	8.2	8.0
Third	20	10.2	9.8	14	10.4	9.7	34	10.3	9.9
Fourth	10	11.0	11.7	6	10.4	11.7	16	10.8	11.8
Third and Fourth	76	12.1	10.7	60	10.1	10.7	136	11.2	10.8

(All weights calculated to the second and thrown to the first decimal.)

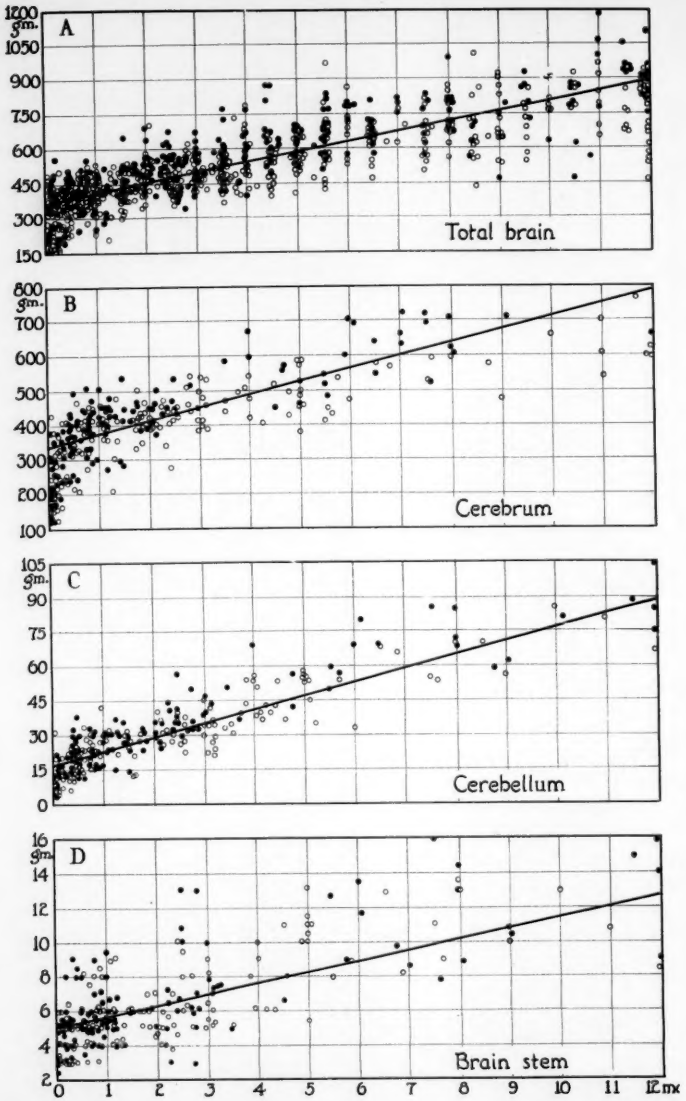

Figure 5. Field graphs showing the distribution of individual records of weights of the total brain (encephalon), cerebrum (cerebral hemispheres and thalamencephalon), cerebellum, and brain stem (pons, medulla and midbrain) in the first year of postnatal life. Males, solid dots; females, open circles. The solid lines drawn through the panel represent the empirical formulae for the weight in both sexes given in Figures 1, 2, 3 and 4.

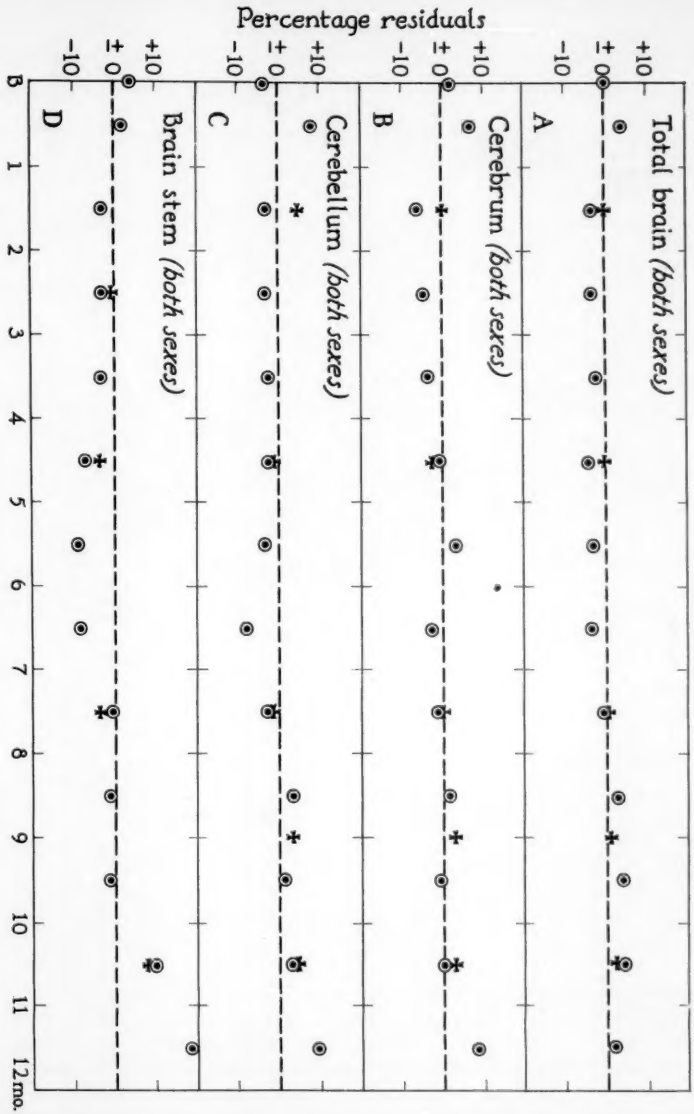

Figure 6. Graphs showing the distribution of relative residuals of calculated from observed values for the total brain and its several parts in the first year of postnatal life. Circled dots, natal and monthly values; crosses, quarterly values.

TABLE 5

TESTS OF GOODNESS OF FIT OF RECTILINEAR FORMULAE FOR THE GROWTH OF THE BRAIN AND ITS SEVERAL PARTS IN THE FIRST YEAR OF POSTNATAL LIFE

	Residuals of Calculated from Observed Monthly Means					Residuals of Calculated from Observed Quarterly Means				
		Mean Absolute (gm.)		Mean Relative (per cent)			Mean Absolute (gm.)		Mean Relative (per cent)	
	N	Wt'ed by N	Unwt'ed by N	Wt'ed by N	Unwt'ed by N	N	Wt'ed by N	Unwt'ed by N	Wt'ed by N	Unwt'ed by N
Total Brain										
Males	637	17.0	26.5	3.2	4.0	732	12.9	14.1	2.2	2.4
Females	582	12.3	16.2	2.5	2.7	676	3.6	3.8	0.6	0.7
Both Sexes	1281	13.3	18.5	2.6	3.0	1493	5.5	6.3	0.9	1.0
Cerebrum										
Males	235	13.0	12.6	3.2	2.5	310	12.5	12.9	2.2	2.3
Females	217	21.0	20.4	5.4	4.2	297	9.8	10.5	2.4	2.6
Both Sexes	452	15.3	15.6	3.8	3.1	607	6.0	6.9	1.1	1.3
Cerebellum										
Males	210	1.5	2.5	4.1	4.3	285	0.7	0.7	2.4	2.1
Females	191	2.1	4.4	5.9	8.0	268	2.1	2.2	5.2	4.8
Both Sexes	401	1.5	2.3	4.4	4.2	553	1.4	1.3	3.7	3.4
Brain Stem										
Males	210	0.3	0.6	3.6	5.9	285	0.5	0.4	4.3	4.2
Females	192	0.4	0.7	5.4	8.2	271	0.3	0.4	4.9	5.4
Both Sexes	402	0.3	0.6	4.1	6.0	556	0.2	0.2	2.5	2.8

(All values calculated to the second and thrown to the first decimal.)

Two additional figures may aid in the exposition of this material. Figure 5 shows the distribution of individual observations. The males are indicated by solid and the females by open dots. The line of central tendency in each case represents the calculated expression for the weight in question in both sexes. Figure 6 is a relative residual graph showing the deviations of calculated from observed values (in per cent of the latter) for the total brain and its several parts. In each instance the observed value is considered as zero and the deviations of the computed values from this base are shown by appropriate symbols in their relative position on the vertical scale.

USE OF THE BIOGRAPHICAL METHOD IN THE STUDY OF MOTOR COORDINATION

E. B. HURLOCK AND G. McHUGH [1]

In the early biographical studies of babies, reports are given of the age at which certain motor abilities, such as sitting, standing, etc., occurred in the individual babies studied. The recent experimental studies of motor development, carried out on large groups of babies as contrasted with single cases used for the biographical studies, have shown slightly different average ages for the appearance of different forms of motor coordination. It therefore seemed to the writers that it would be interesting to compare the two types of studies to see how they agree to differ.

From the many biographical studies, only that material was used which gave the date or approximate time of complete development of a specific motor ability. Four types of comparison were made: 1) comparison of average ages for certain aspects of motor development in babies studied biographically with feeble-minded children; 2) comparison with gifted or exceptional children; 3) comparison with group averages; and 4) comparison with baby test norms.

The different forms of motor activity selected for detailed study were as follows: (a) purposeful reaching and grasping; (b) use of thumb in opposition to fingers; (c) sitting alone; (d) crawling and creeping; (e) standing without support; and (f) walking.

In Table 1 is given a summary of ages at which the six forms of motor activity listed above appeared, as reported by fourteen of the well-known baby biographers:

1. Comparison of Biographical Studies with Studies of Feeble-Minded Children.

A comparison was made of the biographical material with Mead's (19) study of feeble-minded children, so far as age of first walking is concerned. Mead used two groups of children as subjects for his study; the first, the "normal" group, consisted of 25 boys and 25 girls; the second, the "feeble-minded" group, consisted of 144 "schoolable" defectives from the Indiana School for Feeble-Minded Youth, of which 84 were boys and 60 girls.

The ages of walking for his two groups of subjects, as well as the data obtained from the biographical studies reporting the age of first walking are summarized in Table 2.

From Table 2 it may be seen that Mead reports that the median age for normal boys to begin to walk is 13.87 months; for normal girls, 13.21 months; and for both sexes combined, 13.54 months. This is contrasted with a median age of 22.2 months for feeble-minded boys, 20.76 months for feeble-minded girls and 21.6

[1] From Columbia University. The study was suggested, planned and prepared for publication by the senior writer. The junior writer carried out the research work and prepared the tables of figures.

Table 1

Material from Fourteen Baby Biographers Showing the Ages in Months at which Certain Motor Reactions Appear.

Biographer	Purposeful Reaching and Grasping	Thumb Opposition to Fingers	Sitting Alone	Crawling Creeping	Standing without Support	Walking Alone
Shinn		2.25	4.75	8.50	9.00	12.00
Fenton	5.50	3.00	4.25	7.75		12.00
Moore	3.75	3.00		11.00		14.00
Dearborn	4.00	2.50	6.00	12.50	14.00	15.50
Hall	4.50		4.75	13.50	12.13	14.20
Major	4.25	4.25		11.50	12.80	14.50
Preyer	4.75	3.00	9.75	12.25	11.00	15.20
Whipple				7.50	11.00	13.50
Sully	4.75					
Perez					9.00	
Hazzard	4.00	3.30	4.50			
McLeish	4.00	1.15	5.00	13.00		14.00
Myers	3.30					
Warden				10.50		13.00
TOTALS	42.80	23.05	39.00	108.00	78.93	137.90
N	10	8	7	10	7	10
Median	4.125	3	4.75	11.25	11	14
Arith.Average	4.28	2.88	5.57	10.80	11.28	13.79
Range	3.3-5.5	1.75-4.25	4.25-9.75	7.5-13.5	9.-14	12-15.5
A.D. (Average)	.54	.59	1.31	1.79	1.46	.95
S.D. (Average)	.223	.72	1.78	2.08	1.73	1.14

Table 2

Average Walking Ages in Months for Normal and Feeble Minded Groups.

N	Condition	Sex	Authority	Median	Average	Range
50	Normal	Both	Mead	13.54	13.88	11-30
25	Normal	Boys	Mead	13.87	14.28	11-30
25	Normal	Girls	Mead	13.21	13.48	11-18
10	Normal	Both	Biographies	14.00	13.79	12-15.5
7	Normal	Boys	Biographies	13.50	13.77	12-15.2
144	Feeble-minded	Both	Mead	21.60	25.80	12-36
84	Feeble-minded	Boys	Mead	22.20	25.80	12-36
60	Feeble-minded	Girls	Mead	20.76	24.24	12-36

months for both sexes. According to data from 10 biographical studies, the median walking age for 7 normal boys and 3 girls was 14 months which is almost identical with the age reported by Mead for normal children of both sexes.

Wallin (24) in 1927 compiled some statistics relating to certain aspects of motor development in normal and feeble-minded children. His data are presented in Table 3, together with data from biographical studies.

Table 3

Wallin's Data Contrasted with Baby Biographies.

Description of Stages	N	Types and Source	Age	
			Years	Months
A.				
Sitting unsupported	262	Normal (Wallin)	.58	6.96
Sitting unsupported	139	Feeble-Minded (Wallin)	.97	11.64
Sitting unsupported	7	Normal (Biographies)	.46	5.57
B.				
Standing unsupported	291	Normal (Wallin)	1.01	12.12
Standing unsupported	170	Feeble-Minded (Wallin)	1.68	20.16
Standing unsupported	7	Normal (Biographies)	.94	11.28
C.				
First steps unsupported	258	Normal (Wallin)	1.12	13.44
First walked "	343	Normal (Wallin)	1.23	14.76
First steps "	148	Feeble-Minded (Wallin)	1.89	22.68
First walked "	188	Feeble-Minded (Wallin)	2.08	24.96
Walking "	10	Normal (Biographies)	1.14	13.79

Once again, the data relating to the normal baby are very similar to the baby biographies as is shown in the large groups studied by Wallin. There is, however, a marked difference in ages of motor control in normal as contrasted with feeble-minded children, as was reported in Mead's (19) study.

2. Comparison of Biographical Studies with Terman's Study of Gifted Children.

In his investigation of the development of gifted children, Terman (36) recorded the ages of sitting and walking alone as reported to him from physicians' records compiled from testimony given by mothers. This material, together with data from biographical studies for the purpose of comparison of the two, is presented in Table 4.

An inspection of this table will show that the data from biographies coincide fairly closely with Terman's data. A comparison of the median ages for sitting alone shows that the children in the biographical studies were .26 months ahead of the boys and .24 months ahead of the girls of Terman's study. On the other hand,

Table 4

Terman's Data on the Average Month at which Exceptionally Bright Boys and Girls Sit Alone and Walk Alone.

	Sitting Alone				Walking Alone			
Groups	N.	Average	Median	S.D.	N.	Average	Median	S.D.
Boys (Terman)	220	5.96	5.83	1.46	300	13.10	12.87	2.63
Girls "	196	5.88	5.81	1.70	264	12.87	12.72	2.46
Boys and Girls (Biographies)	4 & 3	4.75	5.57	1.78	7 & 3	14.00	13.79	1.14

the median age for walking alone was .92 months later for the biographical group than for Terman's boys and 1.07 months later than Terman's girls.

3. Comparison of Biographical Studies with Group Averages.

Shirley (30, 31), in a study of the development of mental and motor processes over a two-year period, reports data for 25 babies presented in Table 5.

Table 5

Shirley's Data on the Median Ages for Certain Forms of Motor Development

			Medians Age in		Weeks		Weeks
Description of Stage	N	Source	Weeks	Months	Q 1	Q 3	Range
Grasp lying posture	23	Shirley	15	3.75	13	17	
Retain lying posture	23	Shirley	18	4.50	15	18	
Grasp and retain sitting posture	23	Shirley	18	4.50	15	19	
Reach for dangling object	22	Shirley	19	4.75	16.5	21	
Grasp dangling object	22	Shirley	21	5.25	19	22.5	
Purposeful reaching and grasping	10	Biographies	17	4.25			13.2-22
Thumb opposition	23	Shirley	18	4.50	15	21	
Thumb in opposition to fingers	8	Biographies	12	3.00			7 - 17
Sit alone momentarily	22	Shirley	25	6.25	20.5	26	
Sit alone one minute	20	Shirley	31	7.75	27	34	
Sitting alone	7	Biographies	19	4.75			17 - 39
Creep	22	Shirley	44.5	11.12	41	45	
Crawling and creeping	10	Biographies	45	11.25			30 - 52
Standing alone	21	Shirley	62	14.50	56	66	
Standing without support	7	Biographies	44	11.00			36 - 56
Walking alone	21	Shirley	64	15	59	67	
Walking	10	Biographies	56	14			36 - 62

A critical analysis of this table will show not only some striking differences between the median ages of the biographical groups and the groups studied by Shirley, but it will also show the differences in the two types of study. For example, Shirley studied all the intermediate stages leading up to the ability to grasp while the biographers have referred only to the ability as being present with no thorough description of the degree of the ability. For that reason, it is difficult to make a comparison of the two types of study. Whether the earlier appearance of different forms of motor ability in the case of the babies of the biographical studies was due to selection of subjects or to lack of exactness in the reports is difficult to determine. With the exception of creeping, the biographers report an earlier development of each motor activity than did Shirley.

Jones (14), in her study of "The Development of Early Behavior Patterns in Young Children" made systematic observations of such activities as smiling, eye coordination, head support, thumb opposition, reaching, sitting, etc., together with the ages at which the activities appeared in a group of babies. In Table 6 are given the ages at which these activities appeared, together with ages for similar activities as reported by baby biographers.

Table 6

Jones' Data on the Ages at which 50 Per Cent of her Groups of Children Reached the Stages of Thumb Opposition, Reaching and Sitting.

Stage	N	Average	50 Percentile	Source
Thumb opposed	512		4.93 months	Jones
Thumb opposed	8	2.88 months		Biographies
Reaching	486		5.06 months	Jones
Reaching	10	4.28 months		Biographies
Sitting	292		7.23 months	Jones
Sitting	7	5.57 months		Biographies

A comparison of Jones' results with the biographical records shows that the baby biographers tend to place the ages for the appearance of thumb opposition, reaching and sitting earlier than the norms given in Jones' study. In the case of thumb opposition and sitting, the difference is pronounced.

4. Comparison with Baby Test Norms.

Since the appearance of Kuhlmann's (15) Revision of the Binet-Simon Test in 1922, there have been a number of "baby tests" and "norms" of development. While all of these do not agree completely about the age at which the average baby should be able to carry out a specific activity, nevertheless, the agreement is pronounced enough to justify a comparison of these tests with the ages at which baby biographers reported the appearance of similar activities. This comparison is given in Table 7.

As may be seen from this table, the average ages reported by biographers for the appearance of different activities are earlier than the ages given as standards for baby tests. This difference may, to a certain extent, be due to the difference in standards used by the two groups. For example, in "sitting alone", the

Table 7

Age Chart for Comparison of Baby Tests and Biographical Averages.

Description of stage	Biog. Av. Months	No. Biog. Reporting	Test Norms Months	Names of Tests
Purposeful reaching and grasping	4.28	10		
Reaching for seen objects			6.	Kuhlman
Reaching and manipulation			6.	Gesell
Reaches for cube			4.5	Bayley
Picks up 2 cubes			5.2	Bayley
Reaches persistently			6.	Bayley
Unilateral reaching			6.4	Bayley
Thumb opposition to fingers	2.88	8		
Thumb opposition in grasping			6.	Kuhlman
Opposes thumb			9.	Gesell
Beginning thumb opposition			4.1	Bayley
Partial thumb opposition			5.1	Bayley
Simultaneous flexion and thumb opposition			5.7	Bayley
Complete thumb opposition			7.6	Bayley
Sitting alone	5.57	7		
Sitting unsupported			12.	Kuhlman
Sits momentarily without support			8.	Gesell
Sits alone			9.	Gesell
Standing without support	11.28	7		
Standing unsupported			12.	Kuhlman
Stands supporting self			12.	Cunningham
Stands alone			15.	Gesell
Walking	13.79	10		
To Walk without help			18	Cunningham
Walks alone			15	Gesell

baby biographers are not specific regarding how long the baby sits alone at one time while in the different baby tests, specific instructions are given about how long the baby must sit to pass the test. This discrepancy may be responsible for the differences found in connection with the other activities reported.

SUMMARY AND CONCLUSION

A survey of this study brings out the following points:

1. Child biographies do not lend themselves to combination to present a general picture of babyhood because, 1) no two observers record the same thing, 2) most records are anecdotal, 3) differences in situations developed, 4) differences in method employed appear, 5) and differences in criteria for traits as recorded by different biographers occur.

2. From studies of Mead (19), and Wallin (24), there is a definite linking of the development of motor coordination with intelligence.

3. The average child of whom biographical studies have been made is slightly more advanced in the stages of motor coordination selected than normal groups studied by Mead (19), or Wallin (24).

4. The feeble-minded child is definitely retarded in the development of motor coordination.

5. The average child of whom biographical studies have been made compares favorably with the exceptionally bright child, as studied by Terman (36), in the development of motor coordination.

6. The thoroughness in interpretation of stages of motor coordination in group studies makes clear the difficulty of comparing the biographical averages with group averages.

7. There are clear cut advances in objective tests of intelligence for the preschool ages based on the development of motor coordination.

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A CONTINUOUS RECORDER FOR OBTAINING SYNCHRONOUS CURVES OF PHYSIOLOGICAL RESPONSES TO STIMULI IN HUMAN SUBJECTS[1]

N. W. SHOCK*

The following apparatus has been designed and built for the purpose of obtaining simultaneous records of as wide a range of physiological reactions as possible. Changes in pulse rate, relative limb volume, respiratory rate and amplitude, apparent electrical resistance of the skin at two different parts of the body, muscular tension, and gross body movement are recorded photographically by this technique. The essential parts of the apparatus are:

(1) The photo-recorder or camera
(2) The recording unit
(3) The electrical units

Photo-recorder

Figure 1 shows the general arrangement of the apparatus. The photo-recorder (1) and recording unit (2) are shown on the left, while the two Wheatstone bridges for the electrode systems are shown on the right (3, 4). These latter will be more fully described in the section on Electrical Units.

The photo-recorder shown in detail in Figure 2 consists essentially of a synchronous motor geared to draw 5-inch wide bromide paper (Eastman PMC #1, normal, on No. 1 Core) past a 1/16 inch aperture at a speed of eight inches per minute. The motor used has a 500:1 gear reduction attached directly to the 1800 RPM motor[2] (1). The paper supply (in 100 foot rolls) is placed on the upper spindle (2) from which it passes over the rubber covered roller (3) past the aperture (4) through the driving rollers (5) and to the rewind roll (6). Accessory gears are provided so that intermediate paper speeds of 2, 3, and 6 inches per minute may be used if desired. The pointer (5, Fig. 1) revolves when paper is being run through the camera. The opening of the aperture is regulated by a lever (6, Fig. 1). In order to provide a horizontal grid on the record for ease in reading, the aperture is covered by a sheet of celluloid on which vertical lines have been ruled at 1/8 inch intervals. This gives continuous horizontal white lines. The dial (7, Fig. 1) on the record when developed indicates the amount of paper remaining in the camera unexposed, and is operated by the cam (8, Fig. 2). The driving gears are on the outside of the camera box (8, Fig. 1).

Recording Unit

A. General Outline

The separate units are assembled into a large heavy wood box (Figures 3 and 4)

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[1] Acknowledgment for many details in design and construction is due to Mr. F. M. Henry.

[2] Synchronous Motor, Type NSY-12 R. May be obtained from the Bodine Electric Company, Chicago, Illinois.

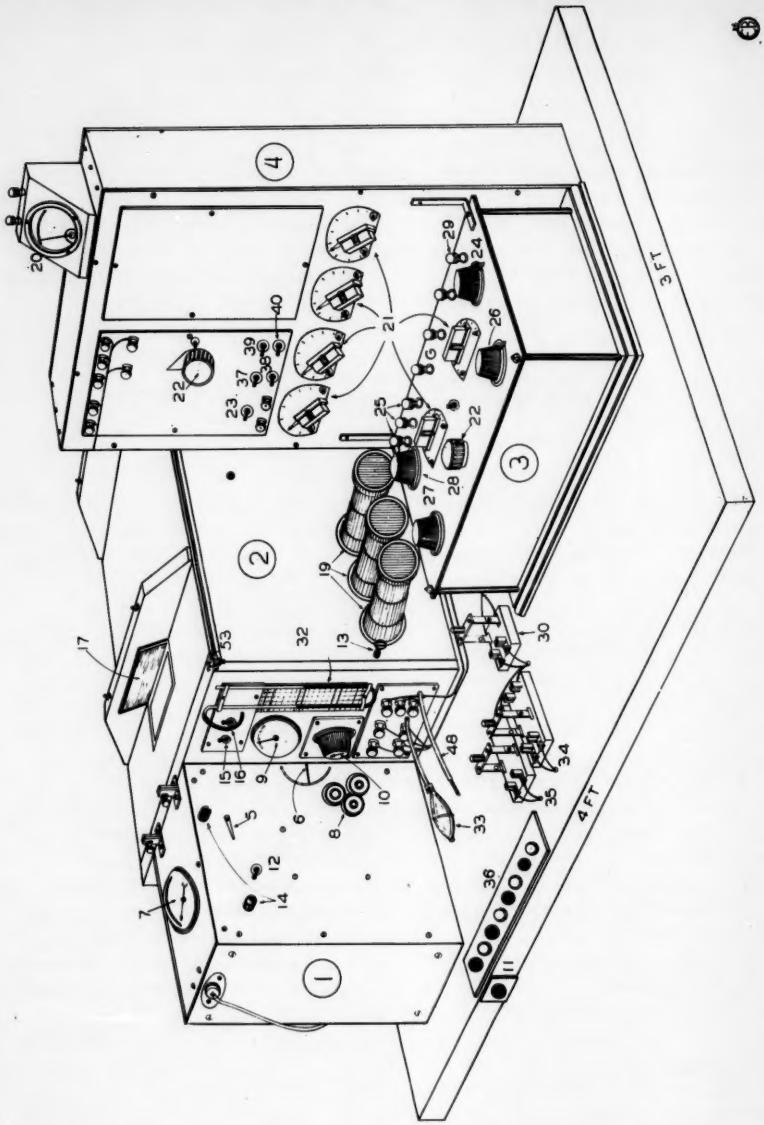


Figure 1

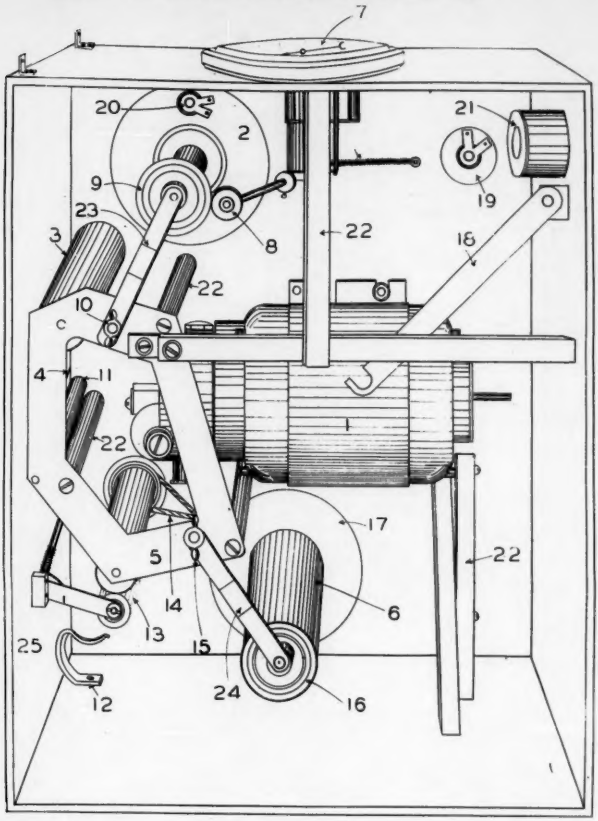


Figure 2

to give stability to the electrical and optical systems involved. Since shadows from pointers and moving light points are both used in this recorder, a light source of relatively low intensity and of parallel beams is needed to provide the grey background on the record. For this purpose a two candle power automobile light is used (1) (see left side of Figs. 3 and 4). The light is placed at the focal point of a 9-inch plano-convex lens (diameter 5 inches, focal length 9 inches) (2). The upper and lower half of this lens were ground off in order to leave the space uninterrupted for the light paths of the galvanometer and blood pressure recording systems which will be described later. Since differences in the sensitivity of the bromide paper occur, a rheostat (3) (see right side of Fig. 3) and voltmeter were placed in circuit with this light so that its intensity could be varied at will or reliably controlled. (These attachments, numbered 9 and 10, also appear in Fig. 1). A telechron motor of one revolution per second (4, Figs. 3 and 4) with vane attached (5, Fig. 4) interrupts the light source at one-second intervals, producing the vertical time lines on the record.

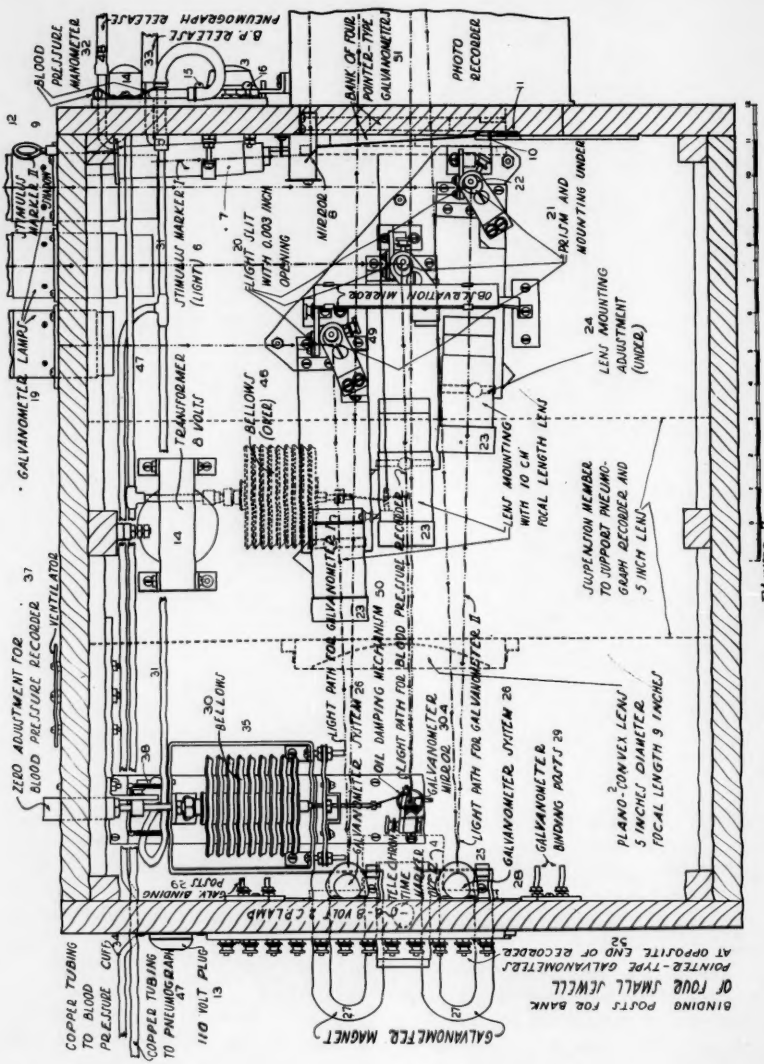

BLOOD PRESSURE MANOMETER
B.P. BELLAST
PNEUMOGRAPH BELLAST
BANK OF FOUR POINTER-TYPE GALVANOMETERS
PHOTO RECORDER
STIMULUS MARKER II
STIMULUS MARKER (LIGHT)
GALVANOMETER LAMPS
FLIGHT SLIT WITH 0.003 INCH OPENING
MIRROR
OBSERVATION MIRROR
PRISM AND MOUNTING UNDER
LENS MOUNTING ADJUSTMENT (UNDER)
TRANSFORMER 6 VOLT
BELLOWS (OVER)
LENS MOUNTING WITH 10 CM FOCAL LENGTH LENS
SUSPENSION MEMBER TO SUPPORT PNEUMOGRAPH RECORDER AND 5 INCH LENS
ZERO ADJUSTMENT FOR BLOOD PRESSURE RECORDER
VENTILATOR
BELLOWS
LIGHT PATH FOR GALVANOMETER SYSTEM
OIL DAMPING MECHANISM
LIGHT PATH FOR BLOOD PRESSURE RECORDER
GALVANOMETER MIRROR
GALVANOMETER SYSTEM
GALVANOMETER BINDING POSTS
PLANO-CONVEX LENS 5 INCHES DIAMETER FOCAL LENGTH 9 INCHES
BINDING POSTS FOR BANK OF FOUR SMALL JEWELL POINTER-TYPE GALVANOMETERS AT OPPOSITE END OF RECORDER
GALVANOMETER MAGNET
COPPER TUBING TO BLOOD PRESSURE CUFF
COPPER TUBING TO PNEUMOGRAPH
110 VOLT PLUG
6-8 VOLT 3 C.P. LAMP
GALV. BINDING POST 23

Figure 8

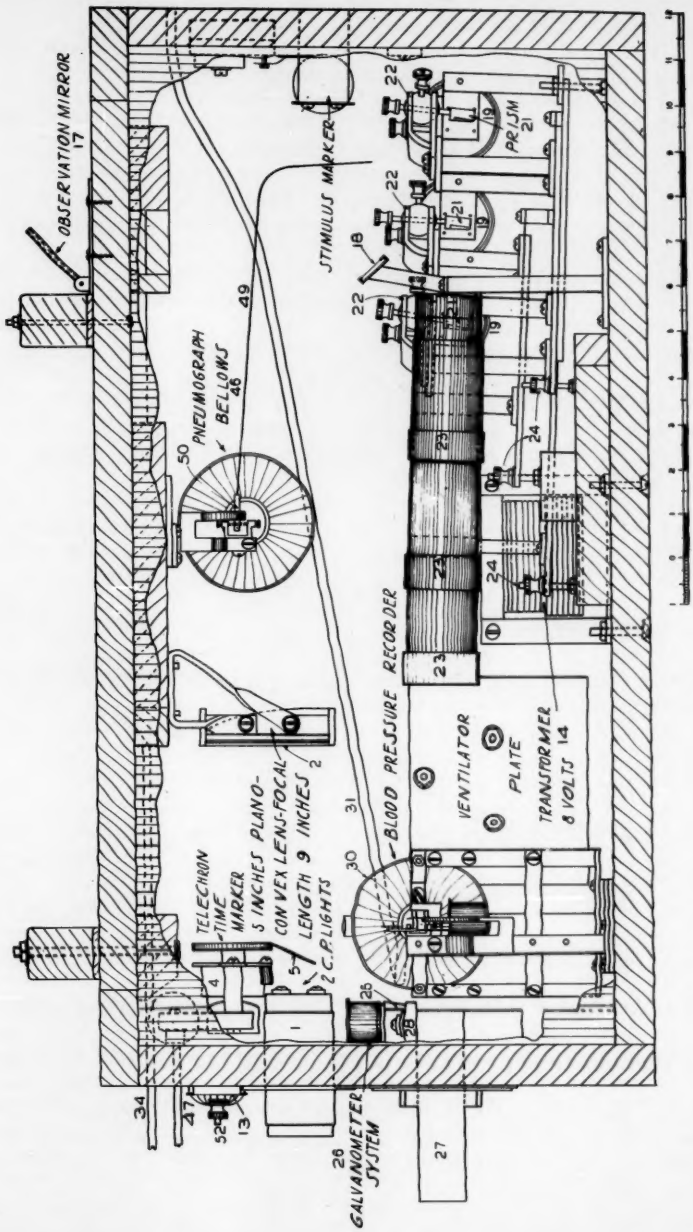

OBSERVATION MIRROR
17
STIMULUS MARKER
18
PRISM
21
22
PNEUMOGRAPH BELLOWS
46
49
50
TELECHRON TIME MARKER
5 INCHES PLANO-CONVEX LENS-FOCAL LENGTH 9 INCHES
2 C.P. LIGHTS
BLOOD PRESSURE RECORDER
VENTILATOR
PLATE
TRANSFORMER
6 VOLTS 14
GALVANOMETER SYSTEM
26
27
23
24
25
28
30
31
34
47
52
13

Figure 4

Two signal markers are provided. The first (stimulus marker I) (6, upper right, Fig. 3) consists of a two candle power lamp mounted in a telescope (7) attached to the front of the recorder box which throws a beam of light on the edge of the photographic paper by reflection at 90° from a mirror (8) whenever the electrical circuit is closed through an appropriate external switch (11, Fig. 1). The second marker (stimulus marker II, shadow) (9) consists of a small lever (10) which is normally held above the background light falling on the camera slit by a spring (11), but which is drawn down to intercept the beam of light, producing a white mark on the edge of the record, whenever the ring (12) is pulled. This is ordinarily used to mark changes in base of the galvanometer recording systems.

From the 110 volt, alternating circuit plug (13) at the back of the recorder box (left side, Figs. 3, 4) leads are connected to the telechron time marker (4) and to an 8 volt transformer (14, upper center, Fig. 3) which provides the necessary current source for the galvanometer lamps (19, upper right, Fig. 3), stimulus marker I (6), background light (1), and also to small two candle power cowl lamps (14) on the front of the recorder box which make it possible to see the blood pressure manometer (32) and voltmeter (9, Fig. 1) when the instrument is used in semi-darkness. Switches to control the various light circuits are also mounted on the front panel (15, 16, Fig. 1).

Mirrors (17, 18) are set at the appropriate angle so that the operator, who sits at the camera end of the recorder, may see the image of the camera slit and check the position of the shadows and light points of the instruments.

B. Galvanometer Recording Systems

In order that the deflection curves might be directly comparable, two identical galvanometer recording units were incorporated into the apparatus. Galvanometer lamps were constructed from 2-inch brass tubing, using lenses of 10-inch focal length and mounted on the side of the recorder box (19, Fig. 3). The light from the galvanometer lamp is focused on a 0.003 inch vertical slit (20) placed directly in front of a right-angle prism (21). The prism is mounted on a universal ball and socket joint (22) so that the light beam can be easily adjusted to pass through the supplementary telescope (23) which contains a lens of 10 cm. focal length. By means of the lens mounting adjustment (24) the image of the light slit (20) is focused on the camera slit by reflection from the plane mirror (25) of the galvanometer suspension. The galvanometers (26) were mounted at the rear of the recording box with the magnets projecting through the end of the box (27).

The proper angle of adjustment was obtained by a clamping device of two tapered brass bars on the magnet pole pieces (28). Intermediate leads were brought to the galvanometer binding posts (29). The galvanometers used were Leeds-Northrup No. 4799-A enclosed lamp scale instruments with a period of 3 seconds, coil resistance, 1,000 ohms, critical damping resistance of 15,000 ohms, sensitivity 0.025 microampere per mm. at 10 cm. In order to use these instruments, the concave mirror with which they are equipped must be replaced with a plane mirror of the same size.

C. Pulse Rate Recorder[3]

The pulse rate recording system consists essentially of a beam of light which is made to deflect across the camera slit with each heart beat by reflection from a mirror attached to a metal bellows actuated by a pneumatic system from the subject's arm or leg. Metal bellows[4] have been found superior to tambours with rubber diaphragms since the former are permanent and need very little adjustment. The middle galvanometer lamp on the side of the recorder (19, Figures 1, 3 and 4) serves as a light source. The light beam passes through the slit (20, Fig. 3) right-angle prism (21), and supplementary lens system (23) in the same manner as the light paths for the galvanometers. However, in this instance the image of the light slit is focused on the camera aperture by reflection from a galvanometer mirror (30-A) attached to the pneumatic bellows (30). The metal bellows is connected by copper tubing (31) to the manometer (32) and release bulb (33) at the front of the recorder, and to the connection to the sphygmomanometer cuff on the subject at the rear of the recorder (34). In this way the cuff on the subject's arm or leg is inflated to a constant pressure, as shown on the manometer (32), by the pressure bulb at the front of the recorder (33, Figs. 1, 4). A detailed drawing of the mounting of the bellows is shown in Fig. 5. The metallic bellows (30) is mounted in a rigid frame (35) which is pivoted at (36). The position of the frame is adjustable by means of the knurled thumb screw (37) which limits the extension of the springs (38). By means of this adjustment the bellows may be operated to give a record at any desired internal pressure of the system as determined by the manometer (32, Figs. 1 and 3). A hexagon nut (39, Fig. 5) holds the bellows from pulling the fine connecting chain (40) out of adjustment when the pressure is released. A plane galvanometer mirror (41) is mounted on a pivoted stirrup (42) and connected by means of a light wire chain (40) to the free end of the bellows on one hand (43) and to a light spring (44) on the other. In order to damp out slight extraneous vibrations of the mirror system caused by interfering factors such as vibration of the camera motor, etc., a vane attached to the mirror and stirrup is suspended in an oil pot (45).

D. Respiration Recording System

A metal bellows, similar to that used in the pulse rate recorder, serves as the essential part in the respiration recorder. Since the necessary sensitivity of this system is considerably less than that of the pulse recording system, the bellows mounting is considerably simplified. The internal pressure used is never much below or above atmosphere so no provision for inflating and deflating is necessary. The bellows is suspended from the under-side of the cross-piece on the top of the recorder box (46, Figs. 3 and 4) and is connected by copper tubing (47) to a pneumograph attached to the subject. A connection is made to a valve at the front of the recorder (48) (Figs. 1 and 3) to provide a zero adjustment to the system after the pneumograph has been attached to the subject. A long pointer (49) which is activated by changes of pressure in the bellows through the pivoted

[3] In addition to changes in pulse rate, the record obtained from this system shows changes in mean volume of the limb. The physiological significance of these changes is still under investigation.

[4] These bellows may be obtained from the Cook Electric Company, Southport Avenue, Chicago, Illinois.

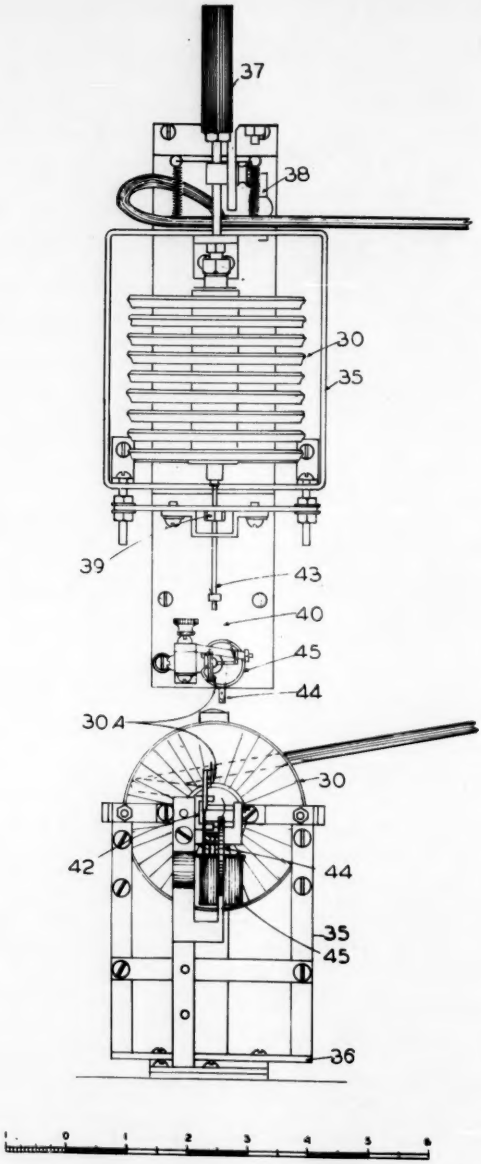


Figure 5

system, (50), casts its shadow on the photographic paper through the camera slit which provides a record of rate and amplitude of respiration.[5]

E. Bed Movement Recorder and Signal Magnets [6]

The record of movement during the experiment is obtained from the electrical changes induced in a secondary coil attached to the bed springs of the cot on which the subject lies and recorded by a small Jewell pointer type galvanometer which casts its shadow on the camera slit. A bank of four such galvanometers has been mounted at the extreme front end of the recorder unit (51) with lengthened pointers of light aluminum wire hanging down over the camera slit. Connections to the various devices used are made through the row of binding posts at the rear of the recorder box (52, Fig. 3 and 4). These galvanometers may be utilized for various purposes. By using two or more coils on the bed, motion of the subject may be noted on the record. A more quantitative estimate of the amount of movement may be made by using several of the galvanometers connected to independent bed coils with varying amounts of current passing through the primaries to give varying degrees of sensitivity of response. In addition, it is possible to use one set of coils at the head and one at the foot of the bed to differentiate head and leg movement on the part of the subject. Due to extreme differences in size of subjects used in this study, such an arrangement was not found feasible and a single coil was used, placed at the middle of the bed. The other magnets were used in automatic marking devices for specific types of stimuli.

Electrical Units

A. Camera and Recorder

The electrical circuits involved in both the camera and recorder units have been discussed somewhat in previous sections and are so simple that further description seems unnecessary.

B. Resistance Bridges for Galvanometer Recording Systems

Since the chief aim of the present apparatus was to provide curves of apparent resistance changes which would be reproduceable and comparable, it was considered essential to utilize the substitution method of recording.[7] In this circuit (Fig. 6) the current through the subject is constant when the bridge is balanced, and slight deviations from balance, as obtained under experimental conditions, produce negligible effects. The two bridges (3, 4, Fig. 1) were built exactly alike with respect to electrical characteristics. Due to the wide range of apparent skin resistances obtained in human subjects, the bridges were built to balance at either 100,000 or 200,000 ohms. Resistances were thus recorded as either 100,000 ohms

[5] At the suggestion of Professor H. E. Jones, a similar recording system connected with a "manual tensiometer," has recently been placed in a symmetrical position to provide a record of changes in muscular tension. The tensiometer will be described in a subsequent report by Dr. Jack Buel.

[6] Dr. Jack Buel suggested and designed this system of recording.

[7] Darrow, C. W. Uniform current for continuous standard unit resistance records. J. Gen. Psychol., 1932, 6, 471-493.

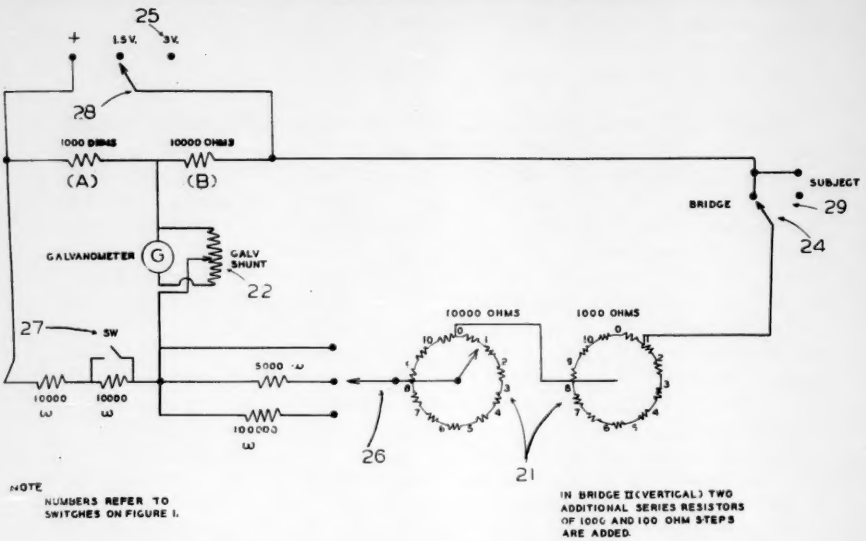


Figure 6
Horizontal Bridge Circuit

or 200,000 ohms minus the amount of resistance in series with the subject at the moment. An impressed E.M.F. of 1.5 at 100,000 ohms or 3.0 volts at 200,000 ohms was used across the bridge, which reduced the current flowing through the subject to about 7.5 microamperes as measured by the microammeter (20, Fig. 1) so that polarization at the electrode was minimized. General Radio Company shielded decade units were used in the series resistors of the bridges (21, Fig. 1). Arryton shunts were built for each galvanometer so that the galvanometer remained critically damped at all intermediate sensitivities (22, Fig. 1).

A short-circuiting switch (23 or 24, Fig. 1) by which the subject is excluded from the circuit, makes it possible to calibrate each curve in 1,000 (or 100) ohm steps so that the resistance changes recorded may be tabulated in standard ohm units, giving a degree of comparability of records not possible when methods other than that of substitution are used. Directions for operation are given in the appendix.

C. Electrodes for Galvanometers

Electrodes consisting of zinc-zinc sulphate solution were used on the hand and foot in the present study. Figures 7 and 8 show the essential construction details of both. Provision has been made to obtain constant conditions of area, moisture, and pressure in each electrode system. In the foot electrode (Fig. 8) the active electrode of 3 mm. zinc, 2½ cm. in diameter (14) slides within a bakelite tube which extends flush with the back board (16) to which the foot is bound rather tightly with a 3-inch bandage. The zinc plate, which is covered with a

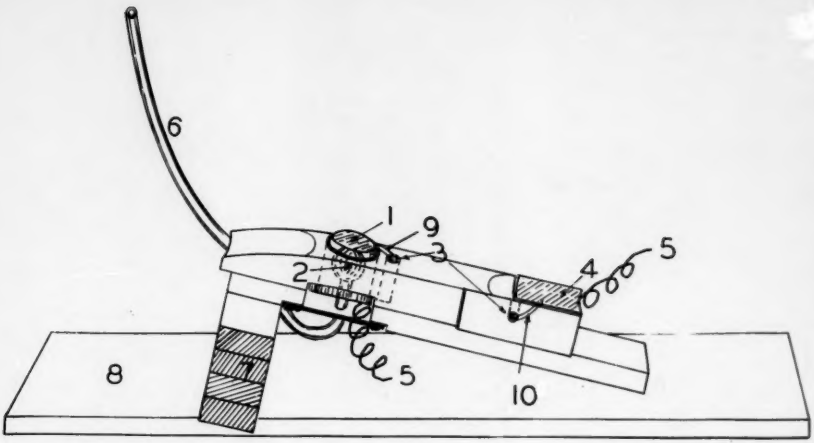


Figure 7

stiff paste of acid-washed kaolin and saturated with zinc chloride and a cotton pad soaked in 0.9 per cent NaCl is held against the sole of the foot by the hydrostatic pressure of a constant head of water (125 cm.) connected by a rubber tube (7) to the rubber balloon (15) lying inside the bakelite tube. The block (2) which is adjustable in the slot (6) for different foot lengths contains a similar zinc plate (3) and balloon (4) arrangement which makes contact with the side of the leg which is bound to the horizontal support (12) by means of long 3-inch bandages. Cotton wicks (16, 17) lead from bottles of water (8, 5) to the cotton pads on the zinc plates (14, 3) to maintain conditions of moisture. The electrode may be adjusted to different foot lengths by sliding the hinged joint (10) in the slot (9) and tightening up a thumb screw at the rear. A cross support (11) prevents the electrode from upsetting on the bed. A spring may also be attached at the outside corners of the two parts (13, 12) to draw the braces up close against the foot and leg to give increased stability to the system. Electrical connections (1, 1) are made to the appropriate binding posts of the Wheatstone bridge. Armored cable, which was grounded, was used in making all the connections from the electrodes to the Wheatstone bridge.

Construction of the hand electrode (Fig. 7) is similar to that of the foot, but somewhat simpler. The active electrode (1) is pushed against the palm of the hand by the hydrostatic pressure transmitted by the rubber tube (6) to the rubber balloon (2). Contact with the under-side of the arm is made by the indifferent electrode (4) by binding the arm to the rest (7) by means of a 3-inch bandage.[8]

[8] Mr. F. M. Henry has suggested the use of strips of rubber dam to bind the electrode to the hand.

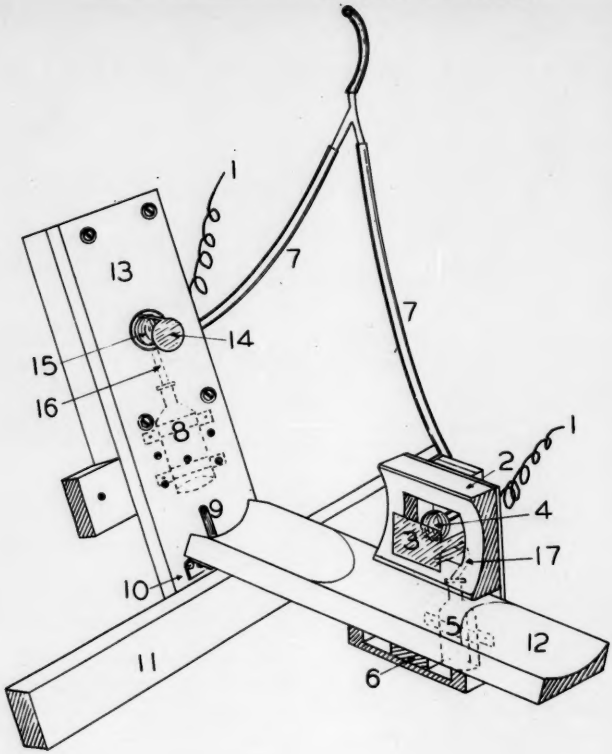


Figure 8

Moisture is maintained by wicks (9, 10) leading from small vials of water (3).

Apparatus Attached to Subject

For the experimental period, the subject lies on a cot inside the stimulus cabinet[9] with the following apparatus attached:

1. A pneumograph around the chest at nipple level is connected with the recording bellows by copper and rubber tubing.

2. The hand electrode, previously described (Fig. 7) is attached to the right hand, and the foot electrode (Fig. 8) to the left foot.

3. A sphygmomanometer cuff with one tube clamped off is placed on the right ankle and connected to the pressure bulb and bellows of the recording apparatus by means of copper and rubber tubing.

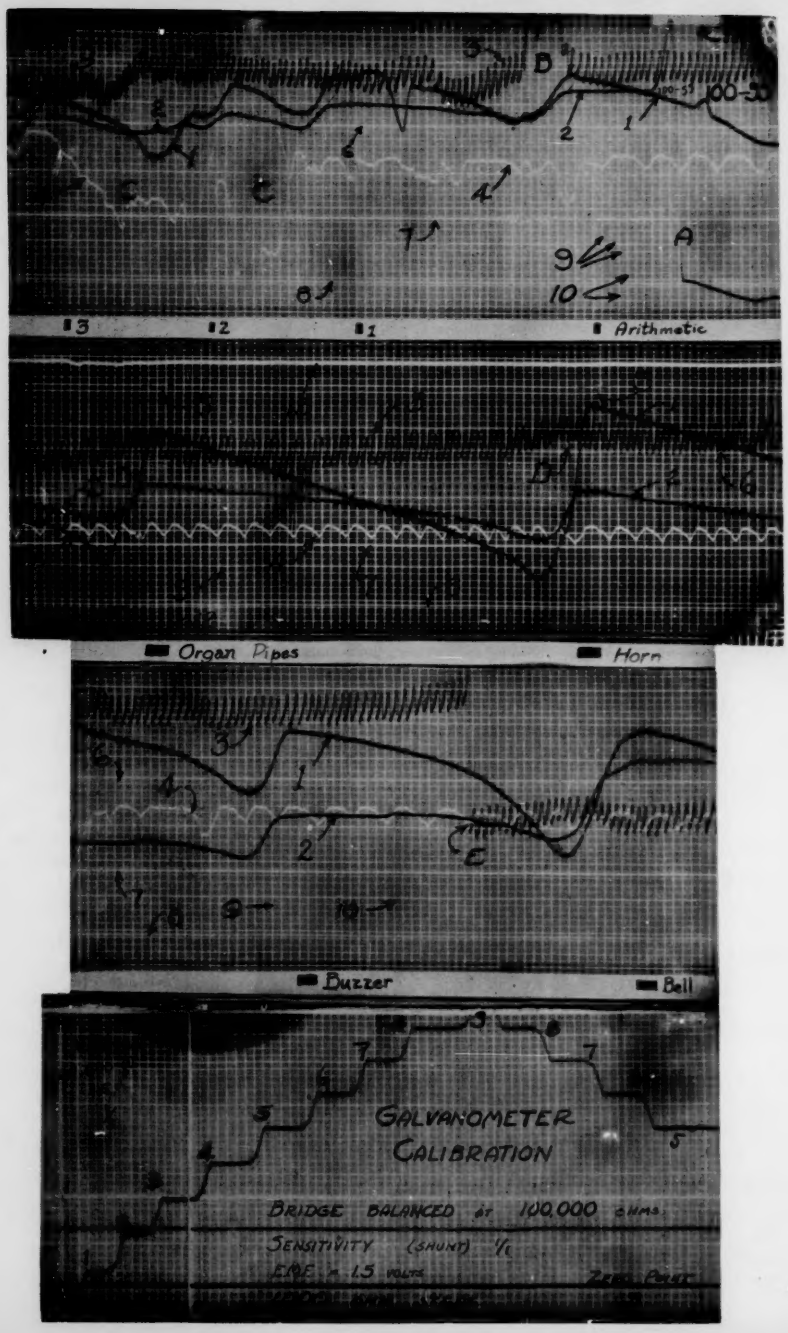

Arithmetic
Organ Pipes
Horn
Buzzer
Bell
GALVANOMETER
CALIBRATION
BRIDGE BALANCED AT 100,000 OHMS
SENSITIVITY (SHUNT) 1/1
EMF = 1.5 VOLTS

Figure 9

Sample Records

Figure 9 shows a sample record obtained in an experiment. The horizontal white lines (9) are produced by the black lines ruled on the celluloid of the camera aperture, while the vertical lines (10) mark intervals of one second. Pulse rate and relative limb volume changes are shown by the black irregular curve (3). The white dash (11) at the top of the record shows what changes in the resistance base were made, while the black marks (12) on the white margin at the bottom mark the incidence of stimuli. (Note that the record reads from right to left). The white line (4) is the respiration curve. The two dark lines (1 and 2) are the record produced by the galvanometers, showing deflections, which indicate changes in apparent skin resistance produced by the stimuli. A calibration curve with 1,000 ohm steps is also shown. The white wavy line (7) is produced by movements of the pointer of the small galvanometer attached to the bed movement recorder. The fine white line (5) is produced by another of the bank of four Jewell galvanometers at the front of the recorder (51, Fig. 2) and in the present series of experiments was used as a reaction time recorder for the association word lists, and to indicate the timing of auditory stimuli. The two other fine white lines (7 and 8) produced by the other two Jewell galvanometers were also used as stimulus recorders. The heavy white line (13) records movements of the subject's hand on the tensiometer.[10] The sections of record shown in Figure 9 illustrate most of the changes which occur experimentally. At B the effect of foot movement is shown, while at C the effects of sighs and deep respiration by this subject are apparent. At D changes in relative limb volume following stimulation are recorded. At E the pressure in the sphygmomanometer cuff on the subject's ankle was increased 5 mm. of mercury.

SUMMARY

An apparatus has been described which provides continuous simultaneous photographic records of (1) changes in apparent skin resistance at two different points of the body, (2) changes in pulse rate and limb volume, (3) changes in respiration rate and motive volume, (4) changes in inspiration-expiration ratio, (5) alterations in muscular tremor, (6) gross body movement.

In addition, means of measuring association time, gross reaction time to stimuli, and other similar characteristics of the response are provided in the instrument.

[9] Jones, H. E. An Experimental Cabinet for Physiological Studies of Emotions.
[10] See footnote 5.

AN EXPERIMENTAL CABINET FOR PHYSIOLOGICAL STUDIES OF EMOTIONS

HAROLD E. JONES [1]

Laboratory studies of emotional processes have frequently suffered from defective technique in the control of the stimulus schedule and of incidental stimulation. In a series of experiments planned at the Institute of Child Welfare of the University of California, the following requirements were formulated:

1. Objective records of response. The response of various autonomic segments should be recorded photographically in a form convenient for measurement.

2. Instrumental attachments. Provisions should be made for rapid and uniform procedures in the attachment to the subject of electrodes, manometer bandages, or other devices required in electrical or pneumatic registry in the investigation of emotions.

3. Control of stimuli. Through electrical and mechanical controls, it should be possible to present emotionally provocative situations in a standardized stimulus schedule.

4. Reproducibility. In a study involving repeated observations, it is particularly necessary that procedure, stimulation, and recording should be reproducible in detail.

5. Comfort of the subject. To facilitate experiments of long duration, the subject should be permitted to recline in a comfortable position and with the possibility of some freedom of movement. He should be protected from unscheduled disturbance due to the recording apparatus or to persons attending to the instrumentation.

It is perhaps particularly true in the study of emotions that external factors which can be standardized may be of little moment in comparison with unstandardizable intra-organic factors. It is also true that in the study of emotions standardization may defeat its own purpose through the requirement of laboratory conditions which in themselves provide a differential emotional stimulation. Moreover, it is of course recognized that laboratory situations are better adapted to the study of episodic emotional states than to the elucidation of emotional trends. Acknowledging these limitations, we still find an important place for laboratory techniques in the study of emotions, and a need for more thorough experimental controls than are ordinarily utilized.

The requirements for the recording equipment, as stipulated above, have been met in an apparatus described by Shock.[2] In order to meet the remaining require-

[1] From the Institute of Child Welfare, University of California.

[2] Shock, N. W.: A continuous recorder for obtaining synchronous curves of physiological responses to stimuli in human subjects.

ments an experimental cabinet was constructed, the main features of which are indicated in Figure 1 (interior view) and Figure 2 (external view).

Explanation of Figure 1

1. Housing for concealed camera (used in facial expression portraits). The camera used is a Leica, with 135 mm. telephoto lens, and also with 50 mm. lens and stereoscopic attachment

2,3,4. Battery of colored lights (used in conditioning experiments)

5. Buzzer

6. Automobile horn

7. Buzzer

8. Bell (mounted on the support for the lights)

9. Geissler tube

10. 120-watt lamp, unfrosted

11. Screen for projection of pictures

12. Loud speaker

13. Aperture for film slide projector

14. Aperture for motion picture projector

15. Mounting for electrodes for left foot (for skin conductance measurements)

16. Manometer bandage (for pulse and mean volume records from right leg)

17. Mounting for electrodes for right hand

18. Push button operated by subject (controlling film slide projector)

19. Induction coil (the coil is attached to the frame of the bed, a soft iron core to the couch spring. Movements of the subject on the couch yield a photographic record through galvanometric registry of changes in current passing through the core)

20. Pillows, adjusting the subject's head in a position for photographs from the camera above

21. Sphygmomanometer for clinical blood pressure records (from left arm)

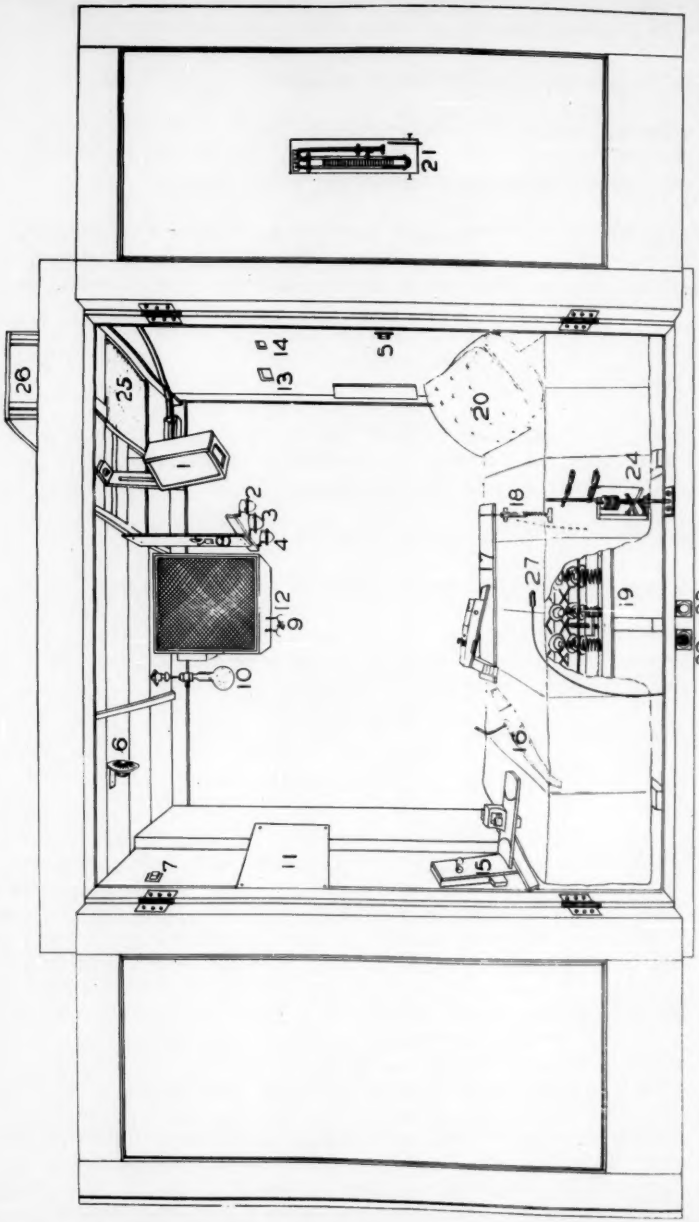


Figure 1

22,23. Foot switches used by experimenter to register stimulus signals on the photographic record

24. Tensiometer for recording manual pressures

25. Diffusing glass

26. Lamp housing and chromaloid reflector for two 500-watt lamps

The inside dimensions of the cabinet are 2'10" by 6'10" by 6'10" high. The doors and ceiling are of wood, the sides of celotex. The physical characteristics of the stimuli will be indicated more specifically in connection with individual reports.

Explanation of Figure 2

1. Celotex wall of cabinet

2. Housing for film slide projector. The projector is enclosed in a wooden box, lined with felt, in order to deaden the sound of the solenoids which control the film movement

3. Bell and Howell motion picture projector

4. Battery of switches to control lights and auditory stimuli

5. Experimenter's winding key to reset Leica camera after picture has been taken. The key operates through a ten-foot flexible extension shaft

6. Cable release for camera

The Use of the Cabinet

Up to the present time the cabinet has been used for approximately 1000 experimental periods averaging from thirty to fifty minutes each. The stimulation schedules include a sequence of lights, buzzers and bells; phonograph records which reproduce radio programs and standardized "sound effects" through the loud speaker; a series of short motion picture subjects; a series of single frame pictures exposed through the film slide projector; a series of odors; mental tasks such as arithmetic problems; a deception test; association words; and a series of short-answer interview questions adapted from emotional inventories. Tests are usually given on two successive days, and repeated after a six-month's interval. During stimulation by the physical stimuli, the doors of the cabinet are normally closed and the subject isolated. For the stimuli requiring timed administration by an experimenter (as the association words) one door is opened and the experimenter sits just outside the cabinet. Also mounted outside the cabinet is a phonograph turn-table and vacuum tube system controlling input to the loud speaker in the cabinet. As adapted for use in presenting auditory stimuli, Figure 3 shows a supporting bar (1) with notches for a guide (2) attached to the tone arm. The notches are spaced in such a way as to provide a control over the duration of stimulation: at

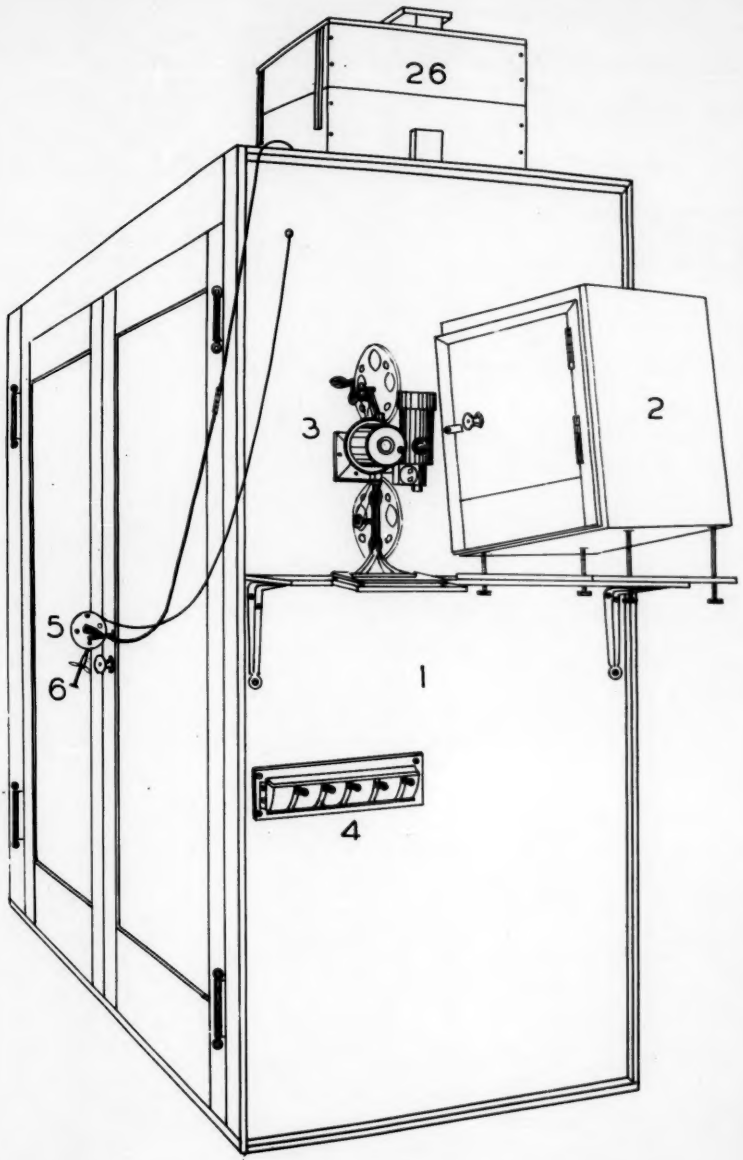


Figure 2

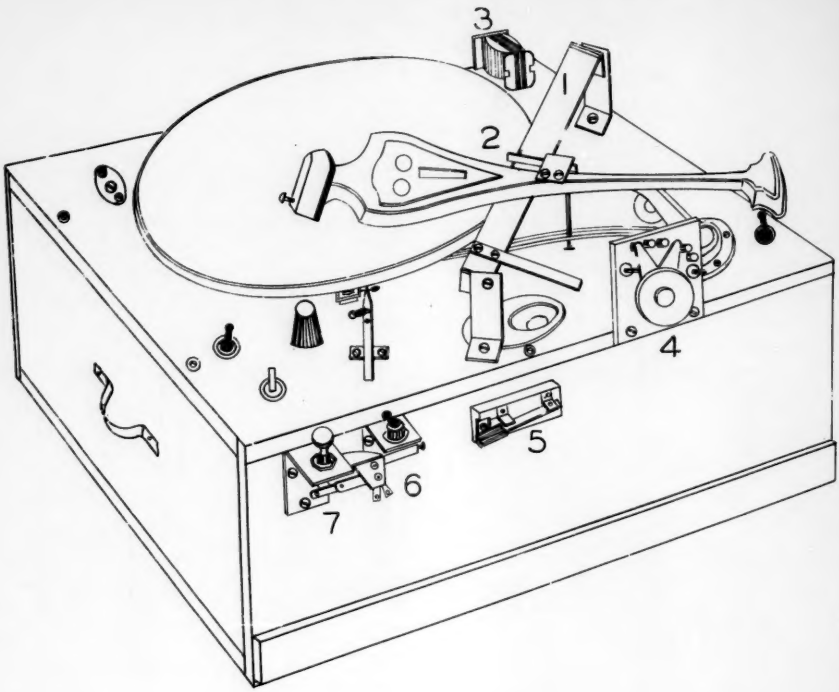


Figure 3

the end of a given part of a record the guide slips into a notch and the next stimulus can be given only after the arm is lifted and advanced; (4) is a supplementary device for auditory stimulation, providing comparatively pure tones through introducing variations in the impedance of a single vacuum tube oscillator circuit; (5) (6) and (7) are control switches.

The equipment illustrated here may at first sight appear to be too complex and unusual to permit of a normal adjustment of the subject; i.e., it may be thought that the initial disturbance produced by this artificial laboratory situation may be such as to overshadow the effects of the specific stimuli. In the case of naive subjects the interior equipment of the cabinet should probably be screened and simplified, and the instrumental attachments reduced in number. This consideration has not seemed to be important in our use of our cabinet, since we were concerned with the collection of cumulative data from subjects who were already familiar with similar equipment before the present series of experiments was undertaken.

The results of a four-year study will be given in forthcoming reports.

"BEHAVIOR MATURITY" OF CHILDREN OF NURSERY SCHOOL AGE

WALTHER JOEL[1]

I

Children (and adults as well) display different degrees of "childish" behavior. They have not gained independence from adult help (e.g. in the mastery of daily routine habits); or they have not learned to control their primitive emotional reactions (anger, fear, pain, etc.); or they are not able to cope adequately with social situations. Independence, self-control, and social attitude are the common criteria of grown-up-ness. For this grown-up-ness which is the opposite of childishness I propose the term "Behavior Maturity".

This is a study of behavior maturity in children of nursery school age and of its relation to chronological age and intelligence.

II

As a convenient objective measure of behavior maturity a rating scale was devised. Some twenty situations were chosen to reveal the child's behavior maturity, i.e. his independence in routine habits (eating, washing, etc.), his emotional maturity (attitude in minor injury, etc.), and his social maturity (group play participation, etc.). In each of these concrete situations, there were listed five possible reactions. After considerable preliminary work the following form was evolved.

(The three columns of figures at the left, representing data for 467 children, are here included for convenience.)

Number	Average age (months)	Weight	
			A. DOES HE DEAL EFFICIENTLY WITH HIS EVERY DAY PROBLEMS? (Routine Habits).
			1. Eating.
96	49.4	7	1. Is always among the first to finish the meal.
134	45.6	5	2. Eats steadily, but is not among the first to finish.
130	44.3	4	3. Needs reminding.
70	42.8	4	4. Is always among the last to finish.
37	47.2	6	5. Shows special difficulties (many food dislikes, complete refusal, vomiting, etc.)
			2. Sleep and Rest.
138	45.4	5	1. Lies quietly at once.
122	46.0	5	2. Does not lie quietly at once, but relaxes without help.
145	46.1	5	3. Needs help to relax.
52	43.8	4	4. Makes disturbance in bed.
10	49.9	6	5. Makes special difficulties (objects to bed, tantrum, etc.).

[1] From Federal Emergency Nursery Schools, Los Angeles, California.

RATING SCALE (Continued)

Number	Average age (months)	Weight	
			3. Toilet.
251	49.8	9	1. Always goes independently to toilet when necessary, without being told.
61	45.0	5	2. Occasionally needs reminding.
74	45.4	5	3. Asks to go, as necessary.
65	34.5	1	4. Goes when called.
16	31.3	1	5. Wets himself (this does not refer to bed-wetting).
			4. Removing Wraps.
100	49.5	7	1. Removes wraps without being told.
165	49.5	8	2. Removes wraps promptly when told to do so.
90	46.4	6	3. Dawdles if not supervised.
88	37.2	1	4. Needs assistance to remove wraps.
24	32.8	1	5. Does not remove wraps by himself.
			5. Washing.
141	49.8	8	1. Washes hands independently without reminder, whenever necessary.
139	47.6	6	2. Works promptly when told to wash hands.
125	45.0	5	3. Needs supervision (washes himself).
57	33.7	1	4. Needs assistance (does part of the work himself).
5	31.2	1	5. Needs to be washed (does none of the work himself).
			B. IS HE LEARNING TO LIVE WITH HIMSELF? (Emotional Maturity).
			6. Did his initial adjustment to the school indicate emotional maturity?
120	47.8	6	1. From the first day at school he fitted into school life, joined group play, without emotional disturbance.
127	46.2	5	2. Stood apart from other children, but showed no emotional disturbance.
116	43.7	4	3. Cried and was unhappy for two or three days.
77	45.5	5	4. Cried and was long unhappy.
27	43.3	4	5. Still makes an emotional scene whenever parent appears at school.

RATING SCALE (Continued)

Number	Average age (months)	Weight	
			7. Does his usual mood show a state of satisfactory adjustment?
73	47.4	6	1. Is never unhappy.
219	45.2	4	2. Is seldom unhappy (only when tired, for example).
108	45.8	6	3. Is easily made unhappy but quick to restore.
63	45.5	5	4. Is easily made unhappy and slow to restore.
4	44.3	5	5. Is usually unhappy (whines, sulks, etc.).
			8. How does he face his difficulties? (for example, when crossed).
58	50.9	7	1. Calmly, peacefully settles difficulty without appeal to adult (or older brother, etc.).
107	45.3	5	2. Makes a fuss, but settles difficulties without appeal to adult.
190	46.0	5	3. Attempts to settle difficulty, but also appeals to adult.
100	43.0	4	4. Does not attempt to settle difficulty; appeals to adult for help.
12	41.9	4	5. Tantrum.
			9. For how long can he be absorbed in an activity?
41	52.7	8	1. Returns to an unfinished activity of the previous day, continues and develops it.
103	48.4	7	2. Pursues an activity until it is finished and is not disturbed by other attractions, but does not return to it from one day to the next.
193	45.8	5	3. Stays with one activity until something more interesting comes up (goes from one constructive activity to another).
76	42.3	3	4. Often interrupts a constructive activity without taking up another one.
54	39.9	3	5. Shifts aimlessly about.

RATING SCALE (Continued)

Number	Average age (months)	Weight	
			10. Can he play by himself?
53	42.8	4	1. Is so self-sufficient that he plays happily alone, even when excluded by the group.
103	41.3	3	2. Plays happily alone, even voluntarily leaves group.
177	48.0	7	3. Prefers group, but in absence of other children can play happily alone.
98	47.9	6	4. Needs the group and always joins the group.
36	45.0	5	5. Is dependent on adult (uses such phrases, for example, as: "Watch what I do," "Look at me").
			11. Is his emotional expression ADEQUATE (directed) or DIFFUSE (irradiating)?
151	46.2	5	1. When emotionally disturbed, he expresses himself immediately against the person or object involved, and then is through with the disturbance.
137	45.5	5	2. His disturbed condition, although immediately expressed, persists somewhat, without however spreading throughout the situation (for example: he talks about it).
106	45.0	5	3. Expresses his emotional state immediately, but the disturbance spreads through the entire situation (if the disturbance occurs, for example, in a play situation, he remains disturbed throughout that situation; if in the orange juice situation, he remains disturbed throughout that situation, etc.).
67	45.3	5	4. Acts inconsistently: at times he discharges his disturbance immediately, at times he carries it over.
6	55.2	8	5. Carries over the disturbance for the whole day against anybody or anything (sulks, etc.).

RATING SCALE (Continued)

Number	Average age (months)	Weight	
			12. Does he take responsibility for his actions?
			When punished:
91	47.8	6	1. Takes his punishment calmly without comment.
208	44.5	4	2. Dislikes punishment but takes it.
51	44.9	5	3. Is resentful ("I'm going to hit you," "I don't like you") but acknowledges guilt.
102	47.1	6	4. Is emotionally disturbed (argues, blames somebody else, never admits himself in the wrong).
15	42.3	4	5. Tantrum.
			13. How does he control himself in a minor injury?
94	47.1	6	1. Pays no attention and goes about his business without any fuss.
100	46.6	6	2. Is disturbed (for example, hits or scolds the object or person that hurt him) but calms down without appeal to anybody.
114	44.9	4	3. Appeals for help only if adult is in sight.
88	46.5	6	4. Behavior varies a great deal (at times he pays no attention, at times he is disturbed, at times he needs help to calm down).
71	42.9	4	5. Is greatly disturbed (cries, talks about it, etc.) and needs help to calm down.
			14. How does he behave in the face of a difficult task?
53	48.4	6	1. Perseveres calmly without appeal to adult until he reaches his goal.
192	46.0	5	2. Keeps trying in spite of failures, but finally gives up without getting emotional.
75	45.8	4	3. Keeps trying in spite of failures, but finally gets emotional and gives up (cries, slams, uses "naughty" language).
119	44.8	4	4. Discouraged by failure, he gives up at once.
28	45.2	5	5. Does not attempt at all ("That's too hard for me," "I don't know that," etc.).

RATING SCALE (Continued)

Number	Average age (months)	Weight	
			15. Does he show initiative?
142	48.1	7	1. Chooses his own occupation irrespective of what others do; gets materials, if accessible, without appeal to adult.
82	46.8	6	2. Chooses his occupation irrespective of what others do, but asks for materials.
187	44.6	4	3. Chooses an activity which is already in progress.
27	41.5	3	4. Must be told what to do.
29	41.6	3	5. Rarely occupies himself with anything.
			16. What degree of social maturity is shown in his play with other children?
29	58.2	9	1. Is socially occupied with games that have rules (hide and seek, etc.).
183	49.3	8	2. Plays simple imitative games in which each child has a special role (house, store, bakeshop, fire-engine, train, etc.).
153	44.5	4	3. Participates in activities in which all do the same thing, that is, in which they play no different roles (block building, sand play, running races, etc.).
85	37.6	1	4. Plays in but not of the group (parallel activity, watching, etc.).
17	37.8	2	5. Has no contact with the group.
			17. How much strain can his social attitude bear?
110	46.6	6	1. Is never unkind, not even to children with whom he quarrels.
74	46.8	6	2. His social attitude breaks down only when he is nervous or tired.
200	44.4	4	3. Is usually kind except when crossed.
59	47.9	6	4. Is unkind if not supervised.
24	44.0	4	5. His attitude is not social (he is spontaneously unkind, even cruel).

RATING SCALE (Continued)

Number	Average age (months)	Weight	
			18. Does he see another's viewpoint?
57	49.3	7	1. Applies "fair play" of his own free will, even where it affects him adversely (he takes turns, cooperates, shares even favorite toys and even with children who are not his special friends).
98	50.9	8	2. Takes turns, etc., of his own free will, with friends only.
210	43.1	3	3. Is willing to take turns, etc., but only when he is reminded by adult.
75	45.3	5	4. When reminded by adult, he sulks but takes turns, etc.
27	40.3	3	5. Even when reminded by adult, he refuses to take turns (argues, cries, tantrum, etc.).
			19. How does he react to unfriendly advances of other children?
64	48.5	6	1. Remains calm and does not appeal to adult.
135	45.1	5	2. Gets emotional (fights, cries, shouts, uses "naughty" language), but does not appeal to adult.
205	46.4	6	3. Appeals to adult, but does not run away.
58	42.6	4	4. Runs away (evades the problem).
5	36.0	2	5. Tantrum.
			20. What is his place in the group?
33	54.4	8	1. Initiates group play; always assumes leadership.
120	49.8	7	2. Initiates group play, but is not always leader (he assumes leadership, for example, in certain restricted activities or in certain restricted groups).
179	45.4	5	3. Is neither leader nor follower (does not assume leadership, but makes himself felt in the group).
100	41.8	3	4. Is always a follower; rarely gets attention from the group.
35	36.5	2	5. Has no contact with a group.

Rate the Child As He NOW USUALLY Reacts

The advantages of this rating scale may be summarized as follows: Not abstract traits are rated, but concrete types of behavior; the rating thus becomes at once easier and more reliable. Ease of rating and reliability are also served by the use of definite statements of specific reactions, instead of such vague terms as "poor", "fair", "average", etc. Another advantage lies in the delay of all comparison until after the rating; the child is rated as he behaves, not as compared with the behavior of other children.

III

The subjects were 230 boys and 237 girls from twenty-two Federal Emergency Nursery Schools and one private school. They ranged in age from twenty to eighty-five months. Only one child was under twenty-three and only six children were older than sixty-seven months. The mean C.A. of the group was 47.2 months.

The children were rated by the nursery school teachers according to the following directions:

Directions. 1. Before the rating, each teacher should read the scale and, with its contents well in mind, observe the children for one week.

2. After a week's observation, the rating should be done jointly by the teachers at a conference.

3. Children who have attended the Nursery School for less than four weeks should not be rated.

4. Start with the first item ("Eating") and rate all children on that item. Then, rate all children on the next item ("Sleep and Rest"). Do the same with the other items of the scale.

5. Make a circle around the number preceding that statement which most nearly describes the child's usual behavior, according to the consensus of opinion of the teachers.

6. Rate the child without reference to his age, his former behavior (except Item No. 6), or any other special consideration.

7. Do not omit a single item. The teachers together should arrive at a rating on every item for every child.

The four weeks minimum attendance requirement serves a twofold purpose. It enables the teachers to become familiar with the child's reactions and gives the child time to overcome any possible initial adjustment difficulties.

The method of joint rating was preferred to independent rating, because the results from the preliminary form of the scale on which the children had been rated on separate blanks by the several teachers had shown a rather close agreement among the different raters. In cases of discrepancies the process of averaging the independent ratings would not produce a more accurate picture of the child, but

would rather make the rating meaningless. A thorough discussion, on the other hand, at each point of disagreement would bring about a more reliable rating.

IV

The term behavior maturity implies the concept of growth or development in time. Hence the natural criterion for validating the rating scale is C.A. An inspection of the average C.A. for each single rating (second column at the left of the rating scale) does actually reveal some relationship between C.A. and the rating steps. Thus, in 15 of the 20 items the children rated "1" had a higher average age than those rated "2", "3", "4", or "5". In 16 items the children rated "5" were of lower average than those rated higher than "5". The average age of children rated "1" and "2" drops below 45 in only one item each, while the average age of children rated "4" and "5" rises above 45 months in only three and four items respectively. The average age of children rated "3", on the other hand, stays between 44 and 46 months, with the exception of two items.

It can also be seen that the ratings on items 3, 4, 5, 8, 9, 10, 15, 16, 18, and 20 differentiate well between behavior at different age levels, and that the ratings on items 1, 2, 7, and 11, on the other hand, contribute less to the measurement of behavior maturity.

For a validation of the scale as a whole, the C.A. of a random sample (the first 117 children) was correlated with the total raw score[1]; the coefficient of correlation was r = .37. By means of the bi-serial r method, regression weights for C.A. were computed and the total weighted score of the sample was correlated with C.A. The coefficient of correlation was r = .72. To test the reliability of these weights, another sample in which the weights had not been determined was used (the next 107 children). The correlation of C.A. with total raw score was .49, with total weighted score (using the weights of the first sample) .71. This result proved the usefulness of the weighting method. A new set of regression weights was then computed, based on the total group of 467 children[2]. The data were weighted and the total weighted score was correlated with C.A. The coefficient of correlation between total weighted score and C.A. for 467 children was r = .65 ± .02. Considering the crude nature of a five-point rating scale, this correlation indicates that the scale is a good measure of behavior maturity.

In order to obtain age norms, the total weighted scores of 467 children were distributed by C.A. Scores and C.A.'s were equated on a percentile basis. The preliminary "Behavior Maturity Age" thus obtained for each child was divided by his C.A. The quotient is called "Behavior Maturity Index". The curve was then empirically smoothed so that the median Index for any given C.A. level approximated 100, and after further extrapolation the following age norms were obtained:

[1] The writer is much indebted to Mrs. Alice M. Horn for her assistance and expert advice on the statistical procedure.

[2] These weights are shown in the third column at the left of the scale.

Total weighted score	Behavior Maturity Age (months)	Total weighted score	Behavior Maturity Age (months)	Total weighted score	Behavior Maturity Age (months)
71	19	91	35	111	51
72	20	92	36	112	52
73	21	93	36	113	53
74	22	94	37	114	55
75	23	95	38	115	56
76	23	96	39	116	57
77	24	97	40	117	58
78	25	98	41	118	60
79	26	99	41	119	61
80	26	100	42	120	63
81	27	101	43	121	64
82	28	102	43	122	65
83	28	103	44	123	66
84	29	104	44	124	67
85	29	105	45	125	69
86	30	106	45	126	71
87	31	107	46	127	72
88	32	108	47	128	78
89	33	109	48	129	79
90	34	110	49	130	80

V

The close relationship of behavior maturity (as measured by this scale) with chronological age might arouse the suspicion that the child's intelligence is an important factor in determining the rating. To clear up this question, I.Q. and Behavior Maturity Index were correlated for 88 children who had been previously tested by the writer with the California Pre-School Mental Scale and who ranged in I.Q. from 60 to 145. The coefficient of correlation obtained was $r = .036$ and indicated that intelligence, as measured by the California Pre-School Mental Scale, did not influence the behavior maturity ratings. This is true, at least, for the group as a whole. It is possible, however, that children of low I.Q. cannot achieve high behavior maturity ratings, while children of average and superior intelligence may be rated low as well as high on the behavior maturity scale. Our data seem to show this tendency but are not sufficient to prove it.

Behavior Maturity Index	California Pre-School Mental Scale I.Q.								
	60 -69	70 -79	80 -89	90 -99	100 -109	110 -119	120 -129	130 -139	140 -149
60- 69					1	1		1	
70- 79	1					3		1	
80- 89		1	2	3	4	5	1	1	2
90- 99		1		4	4	4	4	1	
100-109				1	9	2	1	3	
110-119		1		2	7	2	2		
120-129				1	3	1	1	1	
130-139					2	1			
140-149								1	
150-159									
160-169									
170-179					1				
180-189							1		

VI

SUMMARY

1. Behavior maturity is defined as grown-up-ness or, more specifically, as the degree of independence, self-control, and social attitude reached.

2. A rating scale is presented which may serve as an objective measure of behavior maturity in children of nursery school age.

3. 467 nursery school children with a mean C.A. of 47.2 months were rated. Regression weights for age were computed. The coefficient of correlation of total weighted score with C.A. was $r = .65 \pm .02$.

4. Age norms and scoring key (weights) are presented.

5. The coefficient of correlation between California Pre-School Mental Scale I.Q. and Behavior Maturity Index was found to be $r = .036$.

INTERRELATIONS BETWEEN THE PRESCHOOL CHILD'S BEHAVIOR AND CERTAIN FACTORS IN THE HOME[1]

BERTA WEISS HATTWICK

Those of us who work daily with preschool children have learned that we cannot understand or deal adequately with their behavior unless we know something about their lives at home.

"Is the home a clean, well-regulated one?" "Does it provide the child with sufficient opportunities for play and social contacts?" "Does it give the child the affection and security which he requires?" "Does it give him a chance to help himself?"---It is such questions as these that the preschool specialist has learned to ask. The answers are seldom very specific, for there are few facts available on the relation between specific situations in the home and specific types of behavior in the school. Such knowledge as is available has been gleaned largely from personal experiences. Research has lagged far behind practice in the attempt to seek relationships between the average child's behavior and the life he lives at home.

One reason for such a lag is obvious: there are so many variables in home situations and in children's experiences outside the home that we cannot expect to find invariable relationships---and hence to make predictions with any degree of accuracy---between a given type of behavior in a particular child and a given home factor. In our practical work we shall always need to deal with individual cases and any research which attempts to provide a substitute for this will undoubtedly be doomed to failure.

It does happen, however, when one is working with a large number of individuals, that certain types of behavior tend to occur more frequently in relation to some home factors than in relation to others. Such results as these can be extremely helpful to us if we look upon them not as substitutes for individual analyses---not even as predicting devices---but rather as tools to be used in achieving a speedier and more effective approach to the understanding of the individual case. Such results may be thought of as clues which it will usually be worth our while to refute or verify before we seek other explanations for a particular child's behavior.

The present study was undertaken for the purpose of discovering some of these most frequent relationships between preschool behavior and certain factors in the home. Data on 35 common types of preschool behavior and on 15 home factors which are generally thought to be pertinent to the child's behavior were secured on 335 subjects, all between one year, eleven months and five years eight months of age. Tetrachoric inter-correlations were used as the basis for comparison between the two sets of data. The results rather naturally fall into three large divisions:

[1] From Winnetka Public School Nursery. Paper based on data from the behavior and home settings of 350 nursery school children. The writer wishes to acknowledge the cooperation and helpful suggestions given by Rose H. Alschuler, Director of the Winnetka Public School Nursery and the Chicago Nursery Schools operating under W. P. A. It was this cooperation which has made the study possible.

1. Comparison of behavior under home conditions suggesting over-attentiveness with behavior under home conditions suggesting irresponsibility or negligence.

2. Comparison of behavior under conditions suggesting a well-adjusted home with behavior under conditions suggesting tensions in the home.

3. Study of behavior in relation to situations (a) in which children share home responsibilities with their parents and (b) in which children and parents have common play interests.

The specific items included in the above divisions are indicated in the following pages (see p.204). These items are far from being exhaustive measures of forces operating in the home. Neither do they include all items represented on the home data sheet. They do include all data which on the basis of numbers and reliability seemed adequate for detailed study.

GENERAL STATUS OF THE PROBLEM

Although numerous and diversified opinions may be found as to the relationship between children's behavior and home factors, research studies have scarcely tapped the field. Those studies which have been carried on have dealt largely with children who were above the preschool level and who belonged to the "delinquent" or "clinic" rather than to the "normal" group. They are cited here, nevertheless, for the light which they can throw on the general status of the problem.

Studies to date are agreed in indicating that home factors are important determinants of good and poor adjustment in children. They have also defined the general forces which contribute to mal-adjustment. Stoddard (9) in a report before the National Research Council's Committee on Child Development lists these as follows:

1. Economic handicap
2. Physical handicaps
3. Mental retardation
4. Racial handicap
5. Broken home
6. Parental ignorance and indifference
7. Chronic illness in family
8. Chronic intoxication (or drug addiction) in family
9. Family tensions
10. Parental domination
11. Parental over-solicitousness
12. Minority group handicap
13. Bad companions

While this list is not considered conclusive, Stoddard states that "one can conceive of a search for mal-adjusted children outside all of these categories as a rather difficult affair." (9, p. 2, appendix F.)

Other studies have gone one step further in that they have indicated the relative significance of the factors listed above in the adjustment of the child. Francis and Fillmore (4), for instance, found that parent attitudes are more important determinants of adjustment than are such tangible conditions as economic handicaps, broken homes, foreign born parents and physical sickness. Ward (10) placed economic insufficiency and poor neighborhood at the end of her list of the 10 most adverse factors in the home background of 100 only children referred to a guidance clinic. Louise Stanley (12) in a summary of this topic before the White House Conference said,

"Environmental factors in juvenile delinquency have been studied by various agencies with an increase in our knowledge of predisposing causes of delinquency. However, the fact remains that good children grow up side by side with the delinquent in the same environment, and often in the same family there are well-adjusted and poorly adjusted children. The deciding factor must be in the interplay of personality in the family group." (p.135)

Burgess (1), as a result of his study, and Ogburn (7) have drawn conclusions similar to the above.

Few investigators as yet have taken the next obvious step; i.e., have attempted to tie-up specific home factors with specific types of behavior. All of the investigators previously referred to, for instance, have compared home factors with "good" or "bad" adjustment on the part of children. Some still feel that a search for more specific relationships is fruitless. (13)

It seems to the writer that this is not necessarily the case. As indicated above, even trends toward specific relationships should be useful if accepted for what they are worth. Furthermore, even though the same behavior may be due to quite different and even adverse causes in two different individuals, there is still a chance that the constellation of behavior traits may be distinctive in the two cases and may yield helpful clues. Certainly more attempts to discover specific relationship between behavior and home factors are necessary if we are to clarify our thinking and to hope for findings which will be functional in preventative, diagnostic and remedial work.

The present study represents one attempt to relate specific home factors to specific types of behavior in the child. The few published studies of this sort are not discussed at this point since they seem to fit more advantageously into following sections.

SOURCE OF MATERIAL[1]

Subjects

The subjects of the present study were 335 children (171 girls and 164 boys) from 18 different nursery schools. The children ranged in age from 1 year, 11

[1] A more detailed description of this entire section is filed among the records of the Winnetka Public School Nursery.

months to 5 years, 8 months with the median at 3½ years. The group contained 146 children of American (white) descent, 100 children of Negro parents and 89 children of foreign (mostly Mexican, Italian, mixed European) extraction.

An analysis was made of the fathers' occupations in the case of the 301 children for whom such information was available. These results were compared with the United States census figures of 1920. There were more families in each of the two upper occupational levels (professional and semi-professional classes) in the case of the experimental group than in the case of the population at large. None of the experimental group fell in the fourth occupational classification (farmers). Except for these differences there was striking similarity between the two distributions. The exact proportions follow:

Occupational Levels	Distribution by Occupation (%ages)	
	Present Study (301 cases)	U.S. Census Report 1930
I. Professional	8.93	2.6
II. Semi-professional	9.25	7.2
III. Clerical	15.28	13.8
IV. Farmers		15.4
V. Semi-skilled	24.93	23.8
VI. Slightly skilled	19.93	14.5
VII. Day Laborers	20.60	22.7

Data

The data on both preschool behavior and home factors were secured, in terms of frequency of occurrence, on specially devised rating sheets. Behavior was rated in terms of how frequently it had occurred in the past month: "never," "less than once a week," "once a week," "several times a week," "daily or more." In the statistical analysis the two-fold division was made between the third and fourth of these five categories. For home factors a judgment of "never occurs," "sometimes occurs" and "usually occurs" was required. In the statistical analysis only the two groupings, "never" and "usually," were considered.

The behavior ratings for each child were based on an average of three independent ratings by teachers who were in daily contact with the children. Ratings on the home factors were based on the judgments of one teacher alone. The latter procedure was followed since each teacher in the 18 nursery schools was accustomed to assume responsibility for certain homes and was consequently a better judge of the homes on her list than was any of the other teachers in the group.

On the sheet for rating home factors each teacher was asked to indicate (a) the number of conferences and home visits she had had with each parent and (b) whether she was very sure, moderately sure or not sure of each judgment. Only those ratings were used in which the teacher had reported at least one home visit (usually there were several) in addition to school conferences. Only ratings were used in which the rater was very sure or moderately sure of her judgment.

On items involving personality traits of the parents, each parent was rated separately. In the following analysis the data based on such traits are limited to mothers alone. Sufficient material was not available for the similar analysis of fathers. Such data are being collected, however, so that future analyses of this type may be made.

Since distribution of ratings is an extremely important factor in tetrachoric correlations, the number of records falling in the "usually" and "never" groups in the case of each of the home traits is indicated below. The number of cases falling into the two groupings used for the behavior sheet are not presented here but have been placed on file in the Winnetka Nursery unit:

Classification	Occurrence		
	Never	Usually	Total
Mother favors child	81	100	181
" over-solicitous	135	33	168
" babies child	112	40	152
Household revolves around child	154	81	235
Mother irresponsible	186	47	233
" negligent	190	51	241
Home calm	73	111	184
Mother cheerful	17	170	187
" fatigued	116	27	143
" ill	144	25	169
" nervous	147	31	178
" impatient	111	26	137
" quarrelsome	96	14	110
Child shares home work	72	133	205
Child shares play	42	175	217

Reliability of Material

The reliability of each teacher's ratings was determined on both forms by comparing judgments made on the same children one week apart. The agreements for the behavior sheet (based on an average of 104 judgments each) ranged from 73 to 96% for the individual teachers with a median of 85%. The agreements for the home rating sheet (based on only 17 judgments each) ranged between 80 and 100%. For the entire set of data used in determining reliability (221 items) the agreement on the home data sheet was 94.6%.

Validity

In the case of behavior ratings, the agreement of an individual teacher with the average of three could be used as one check on validity. Such a comparison (based on 69 to 157 judgments for each teacher on a random sampling of traits) yielded a median agreement of 89%. The agreements ranged from 77 to 98%.

Since validity might easily be greater for some traits than others, the agreement of individual teachers with the average of three was secured for each behav-

ior trait on a random sampling of the data. Agreements of 71 to 80% were obtained for "seeks attention by showing off," "asks unnecessary help," "seeks praise," "wastes time at routines," "leaves tasks incomplete," "daydreams." Agreements of 90% or above were found for "sucks thumb," "fears," "hard to reason with," "shrinks from notice," "jealous," "has temper outbursts," "breaks toys," "tells fanciful stories," "misrepresents facts." The relatively larger number of judgments of "never" which occurred in these types of behavior probably explains the higher agreement found here. Agreements for the other types of behavior ranged between 80 and 90%.

The check on validity used above was not available in the case of the home data sheet. Internal consistency has therefore been used as the main check on the validity of this material. For each of the larger home factors studied, such as over-attentiveness, several separate approaches have been made, and parallel analyses of results have been presented. The exact comparisons will be found in the description of findings. It is sufficient to state here that none of these various approaches, within a given larger grouping, yielded contradictory results.

As a working criterion of validity on the home data sheets, each teacher was also asked to give her own definition of the traits which she rated. Typical definitions are given in each section of the report. No statistical analysis was made of these definitions. In general, however, the teachers were well agreed on the meaning of the terms employed.

Stability of Factors on Home Data Sheet

Unless the traits listed on the home data sheet remain characteristic of the home over a period of time, they cannot be expected to exert a very lasting effect on the behavior of the child. For this reason it was of interest to know how much agreement would be found between ratings made six months apart by the same teacher on the same home. The number of homes available for such a comparison was only 43. Agreements for this small number of cases (when based on the two-fold classification used in the treatment of results) ranged from 81% in the case of parent over-solicitous to 100% in cases of parent ill, parent impatient, parent irresponsible.

Treatment of Data

All of the comparisons presented in the following pages are based on tetrachoric correlations between the home traits--- divided into the two groups "never" and "usually"---and the children's behavior---divided into the two groups "occurs once a week or less" and "occurs several times a week, daily or more."

In interpreting these results an 'r' of less than .20 has been considered insignificant. A correlation which lies between .20 and .50 has been taken as an indication of a definite, though low, relationship. It should be noted that in a study of this kind, with its large number of uncontrolled variables, a correlation of .20 to .50 probably has more than its usual significance from a practical standpoint.

Probable errors are not presented with the correlations in the following tables. This is because probable errors for tetrachoric correlations do not justify themselves in the light of (a) the general doubtfulness as to their significance and (b) the relatively great amount of labor which they involve. In order to give the reader some basis for estimating the applicability of the present findings, however, a group of sample probable errors was secured. These indicated that a coefficient of .30 or above, based on 170 cases, is in general statistically reliable in the present set of data. Coefficients of .20 to .30, based on the same number of cases, fall just short of this criterion, an indication that the same results would probably, but not invariably, be found in another sampling.

Since the reliability of tetrachoric correlations is partially dependent upon the proportion of the total cases falling in each category, such information should be included in any complete presentation of the study. These data proved too unwieldy for inclusion here, however, and have consequently been placed on file at the Winnetka Nursery Unit. The frequency of parent characteristics (p.204) gives a partial picture of this distribution.

I. OVER-ATTENTIVENESS IN THE HOME

Four traits were listed on the Home Sheet which would seem to characterize over-attentiveness in the home. These traits, with typical definitions given by the teachers at the time of rating, follow:

1. Parent favors child: Parent "gives in to the child whether he is right or wrong." Parent "lets child have own way."

2. Parent is over-solicitous: Parent "expresses concern over trifles, is over-anxious."

3. Parent treats child as baby: Parent "doesn't let child do things he could do for himself." Parent "makes unnecessary choices and decisions for the child."

4. Household revolves around child: "Child is given first consideration in everything." "Everything at home is planned with the child in mind." [1]

As the definitions show, the four traits do not necessarily represent ways of saying the same thing. The distinctions seemed quite clear to the teachers in the case of the first three categories. The meaning of the fourth category was more open to question and it, therefore, cannot be interpreted as safely as the rest.

While the four categories are not identical, they would seem to have the element of over-attentiveness in common. To determine whether there is any marked relation between the traits as rated by the teachers, the following tetrachoric inter-correlations were obtained:

[1] Note: This might be true of the sensible, well-planned household without over-attentiveness entering in at all. Such a possibility might account for the lower inter-correlations of this trait with others in the group.

	Mother Favors[1]	Mother Babies[1]	Mother Over-Sol.[1]	Child Center of Home
Mother Favors	--	.83	.61	.56
Mother Babies	.83	--	.91	.58
Mother Over-Solicitous	.61	.91	--	.75
Child Center of Home	.56	.58	.75	--

[1] The data on favoritism, babying, and over-solicitousness are based only on mother ratings since sufficient data on fathers were not available for classification in this way.

The tabulations reveal definite, high relationships between the four categories. In other words these traits, as conceived by the teachers, do have something in common. It seems safe to assume that over-attentiveness is the common element involved.

The high inter-relationship noted above made it seem fruitful (a) to secure parallel comparisons of preschool behavior in relation to each of the four groupings and (b) to analyze this material particularly for similar trends. Inasmuch as the four groups are not identical, some variability in results is to be expected. In the present analysis, however, it is the consistent trends which will be emphasized, since it is these which suggest that over-attentiveness is operating.

Correlations on the three maternal traits---favoring the child, babying the child, being over-solicitous in care of child---are presented separately for the reasons given above (i.e., so that consistency of trends may be used as a check on validity.) In order to secure a more convenient summary of the relation of maternal over-attentiveness to behavior, however, correlations based on a combination of these traits are also given.

Data on paternal over-attentiveness are not given here since sufficient material was not available for such analysis at the time of this writing. More data are being collected, however, and it is hoped that a report on paternal attitudes will be available in the future.

The Findings

Table I contains the tetrachoric correlations between the various measures of over-attentiveness and the 35 common types of preschool behavior for which correlations were obtained. Several types of behavior which were on the inventory were not included in this report because they did not occur frequently enough to justify statistical analysis. Enuresis, speech difficulties and daydreaming are examples of behavior excluded for this reason. Behavior was grouped under the heading "tendency toward + relationship" if: (1) one or more of the home factors with which it was correlated yielded an 'r' of .20 or above; (2) the majority of the correlations were positive in nature; or (3) there were no negative correlations sufficiently high (.20 or above) to contradict the positive finding. The same reasoning holds for other classifications in this and in following tables.

TABLE I

Relation of Preschool Behavior to Various Measures of Over-Attentiveness in the Home

BEHAVIOR	Correlation				
	Combined Traits[1]	Separate Traits			
		Mother Favors	Mother Babies	Mother Over-Sol.	Child Center of Home
Signs of positive relationship in one or more groupings					
Shrinks from notice	.38	.32	.19	.02	-.01
Wastes time at routine	.36	.42	.05	.16	-.15
Has nervous habits	.33	.38	.20	.14	-.02
Is jealous	.32	.22	.24	.28	.13
Is tense at rest	.30	.32	.13	.03	-.07
Refuses to share	.30	.24	.32	.25	.05
Asks unnecessary help	.30	.38	.20	.02	.12
Cries easily	.29	.41	.32	.15	.22
Avoids play with others	.29	.22	.50	.37	.22
Avoids risk	.28	.36	.18	.17	.42
Stays close to adult	.28	.19	.40	.25	.30
Tells fanciful stories as real	.24	.22	.00	.04	.00
Attacks others	.24	.19	.26	.38	-.02
Leaves tasks incomplete	.20	.26	.11	.02	-.05
Grumbles	.20	.26	-.02	.19	.16
Dawdles	.16	.25	.08	.19	.30
Resists at rest	.16	.45	.02	.12	.05
Rushes into danger	.16	.20	.16	.02	-.03
Looks for praise	.15	.15	.13	.02	.25
Refuses food	.12	.18	.00	.16	.19
Hard to reason with	.08	.10	.16	.21	-.02
Has temper outbursts	.05	.21	.13	.33	-.05
Sucks thumb	.05	.20	.05	.14	.25
Sulks	.03	.20	-.02	.11	-.10
Has fears	.03	.18	.20	.10	.12
Seeks attention by showing off	.00	.13	.23	.08	.01
Signs of negative relationship in one or more groupings					
Takes property of others	.11	-.19	-.39	.07	-.29
Mistreats animals	-.15	.00	-.12	-.14	-.39
Breaks objects	.00	-.07	.13	-.04	-.27
Misrepresents facts	.06	-.09	-.16	-.16	-.17
Bosses other children	.14	.01	-.21	.03	-.10
Behavior showing no definite relationships					
Refuses to comply	.00	.10	-.02	.12	-.05
Ignores requests	.11½	.17	.12	.04	-.16
Grabs toys	.00	-.05	.04	.05	-.14
Criticizes Others	.00	-.02	-.14	-.10	.11
Number of cases on which correlations are based					
Range	234	145 to 183	142 to 187	158 to 168	221 to 235
Median	234	181	152	168	235

[1] Only the three maternal characteristics (parent favors, parent babies, parent over-solicitous) are included in this composite grouping.

TABLE II

Relation of Preschool Behavior to Irresponsibility and Negligence
(Data Based on Mothers' Characteristics Only)

Children's Behavior	Correlations	
	Mother Irresponsible	Mother Negligent
Tendency toward positive relationship		
Misrepresents facts	.36	.35
Has temper outbursts	.36	.16
Seeks attention by showing off	.34	.23
Mistreats animals	.33	.14
Grumbles	.31	.12
Takes property of others secretly	.30	.14
Breaks objects	.26	.25
Sucks thumb	.24	.28
Seeks praise	.23	-.03
Asks unnecessary help	.23	.17
Leaves tasks incomplete	.23	.08
Attacks others	.23	.07
Relates fanciful stories as real	.22	.02
Has nervous habits	.22	.20
Hard to reason with	.22	.07
Ignores reques'	.21	.08
Cries easily	.20	.16
Refuses to share	.20	.01
Tendency toward negative relationship		
Dawdles	-.26	-.18
Tense at rest	-.09	-.22
No definite relationships		
Sulks	.18	.16
Grabs toys	.18	.08
Has fears	.17	.01
Jealous	.12	.03
Refuses to comply	.12	.07
Avoids play with others	.11	.03
Criticizes others	.07	-.05
Rushes into danger	.06	.00
Avoids risk	.04	.02
Shrinks from notice	.02	-.01
Refuses food	.02	-.02
Wastes time at routines	.02	-.01
Stays close to adult	.00	.01
Resists at rest	-.03	-.07
Bosses others	-.06	-.10
Number of cases on which correlations are based		
Range	207-233	220-241
Median	230	240

The writer has grouped the results in the following discussion so as to provide a generalized picture of the data.

As might be expected, there are marked differences in the degree of relationship found between each of the measures of over-attentiveness and each type of behavior. What is more significant, however, is the fact that general tendencies are quite consistent.

The total picture presented by Table I is essentially that of a group of children with many infantile reactions. They tend to waste time at routines, ask unnecessary help, cry easily, leave tasks incomplete, dawdle, resist at rest, be hard to reason with, have temper outbursts and suck their thumbs.

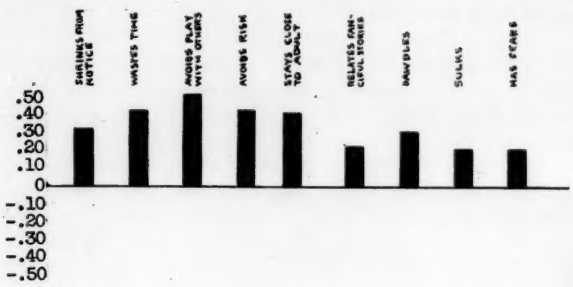
The table also reveals a preponderance of withdrawing as contrasted with aggressive reactions. These children tend to shrink from notice, waste time, avoid play with others, avoid risk, stay near adults, tell fanciful stories, dawdle, sulk, show fears. They show few aggressive tendencies such as attacking others, bossing, refusing to share, refusing to comply, rushing into danger, breaking objects, taking property, etc. There are as many negative as positive relationships between over-attentiveness and this latter group of traits. These contrasts between withdrawing and aggressive tendencies are pictured graphically in Figures 1 and 2.

The positive correlations between the over-attentive measurements and asking help unnecessarily, staying near adults and seeking praise indicate that children who receive too much attention at home are dependent on adults. The positive correlations with avoiding play with others, refusing to share and attacking others also indicate that these children are poorly adjusted in relation to other children.

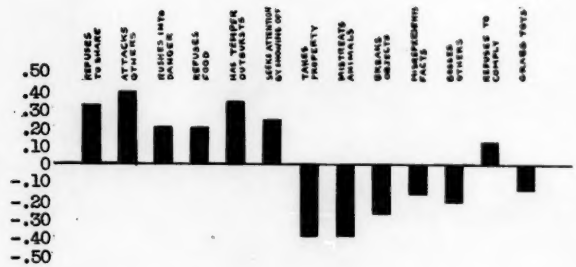
Not only are children who receive too much attention at home poorly adjusted in social relationships but they also seem to lack emotional control. There are positive correlations between the various measures of over-attentiveness and crying easily, nervous habits, jealousy, tenseness at rest, temper outbursts, sulking, grumbling and fears.

The few tendencies toward negative correlations which were found between behavior and over-attentiveness are in keeping with the tendencies discussed above. Misrepresenting facts, breaking objects, bossing other children, taking property and mistreating animals are all aggressive traits. Hence we should expect negative or negligible correlations here rather than positive relationships.

One other type of behavior (negativism) remains to be discussed in relation to over-attentiveness. The tendencies toward positive relationships between the measures of over-attentiveness and hard to reason with, resisting at rest and refusing food indicate that negativism is a factor in some cases. The lack of definite relations between over-attentiveness and refusing to comply and ignoring requests suggests that there is not so marked or consistent a relation here as there is in some of the other types of reactions. There are two possible explanations for this in the home: (1) the over-attentive parent is liable to let the child have his own way and hence to permit few opportunities for actual refusal to arise; and



I. Withdrawing Behavior



II. Aggressive Behavior

Figures I and II: Relations Found Between Withdrawing and Aggressive Behavior and Certain Measures of Over-Attentiveness in the Home. (On this chart the largest correlation obtained between the given behavior and any one of the four measures of over-attentiveness has been plotted).

(2) if the child is dependent on adults, he will naturally be more compliant in routine matters, and hence show less of the resistance which is apt co come when children want to help themselves. The carry-over of these explanations to the school situation, however,(where the behavior ratings were made) seems doubtful.

II. THE IRRESPONSIBLE OR NEGLIGENT MOTHER

Only two traits were included on the home data sheet which would seem to indicate the reverse of over-attentiveness. As the definitions show, these two traits are not identical:

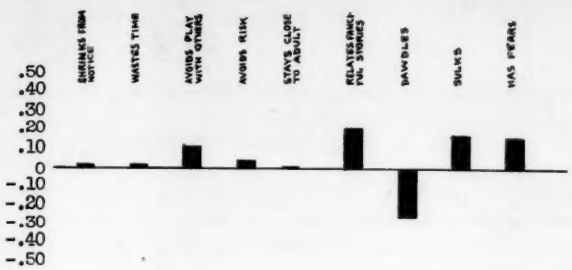
> Parent Irresponsible: "Parent may mean well but can't be depended upon. Is inconsistent in handling the child or household affairs."
>
> Parent Negligent: "Parent doesn't give the child enough attention." "Fails to take proper care of child."

The term 'negligent' seems to convey a clear-cut picture of neglect. The term 'irresponsible' seems to convey more of a picture of inconsistency. Both terms agree in indicating some lack of attention. This agreement is apparently greater in the minds of the teachers than the definitions would indicate since the tetrachoric correlation between the two (based on 219 cases) was .86. This correlation makes it interesting to seek similar trends as was done in the preceding section.

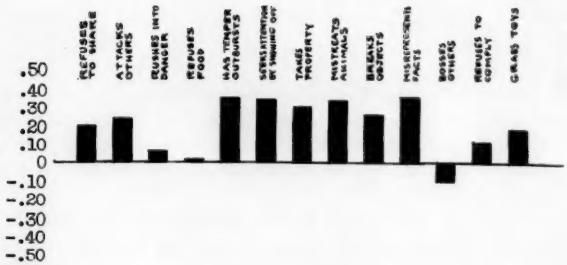
The number of mothers who were rated as being "usually irresponsible" or "usually negligent" were so few in number that the two classifications used in making these comparisons were necessarily expanded to "never", and "sometimes or usually". While this makes the distributions and possibly the size of the coefficients somewhat different from those of other sections of the report, it should not affect any comparisons made between sections on the basis of trends. The rather different definitions received for "irresponsible" and "negligent" made it seem best not to seek a composite set of coefficients for these data.

Table II contains the correlations obtained between the two traits "irresponsible" and "negligent" and pre-school behavior. This table also gives a rather suggestive picture, and one quite different from that presented by Table I.

The child whose mother is irresponsible, according to Table II, shows tendencies to "seek attention by showing off," "seek praise," "ask for unnecessary help," "tell fanciful stories as real," "suck his thumb," "have nervous habits," "grumble," "cry easily," "have temper outbursts." This group of behavior traits represents many reactions which are typical of children who are seeking to gain the attention and security which they lack. It therefore suggests that irresponsibility on the part of the mother is tied up with emotional tensions and insecurity on the part of the child. These types of behavior are not all so definitely related to negligence as to irresponsibility, though the positive correlations with "seeks attention by showing off," "sucks thumb," and "nervous habits" suggests that insecurity is also present here. The small number of clear cut relations in the case of negligence might be due in some measure to the fact that



III. Withdrawing Behavior



IV. Aggressive Behavior

Figures III and IV: Relations Found Between Withdrawing and Aggressive Behavior and Certain Measures of Inadequate Attention in the Home. (On this chart the largest correlation obtained between the given behavior and either measure of inattentiveness has been plotted).

such behavior as bidding for attention has more chances of being successful in the case of irresponsible than in the case of negligent mothers.

A comparison of tables one and two indicates that several types of behavior, including some mentioned above, as "asks for unnecessary help," "sucks thumb," were positively related to both over-attentiveness and in-attentiveness. If we continue to examine the tables, we find that these types of behavior occurred in different settings in the two instances. "Asking for unnecessary help," for instance, was, in the case of children with over-attentive parents, associated with other infantile behavior which indicated a lack of opportunities to "grow up" and hence a real inability to help themselves. In the case of children from homes which reflected inadequate attention, this same behavior was associated with reactions (as "bids for attention" and "jealousy") which are indicative of poor emotional adjustment. Here "asks for unnecessary help" seemed not be be motivated by the actual need for physical assistance, but served rather as an attention-getting device.

Further examples of the above points are found in "sucks thumb" and "cries easily," which yielded positive correlations in both tables. The clusterings in which they occur in the two settings suggest that in the case of over-attentive parents, both types of behavior are indicative of infantile habits, while in the case of in-attentive parents they are indicative of deeper emotional tensions. Actual case studies of individual children give further evidence that the above discussion is sound.

Table II definitely reveals more aggressive than withdrawing tendencies. There are positive relationships between negligence and irresponsibility and "misrepresenting facts," "mistreating animals," "taking property of others," "breaking objects," "attacking others" and "refusing to share." There is only one marked correlation between irresponsibility or negligence and any of the behavior of a withdrawing nature. That correlation is a negative one. It indicates that the child whose mother is in-attentive in the above two ways is less liable to dawdle than are other children.

The relationships mentioned above are indicated in Figures 3 and 4. The comparison of these charts with those in Figures 1 and 2 presents an interesting and striking contrast. Just as withdrawing behavior characterizes the child from the over-attentive home so aggressive behavior tends to characterize the child from the inattentive setting.

The positive relation between irresponsibility or negligence and such behavior as "misrepresents facts," "secretly takes property of others," and "mistreats animals" deserves special mention. These are types of behavior which at a later age are commonly associated with Juvenile Delinquency. Many studies - (2), (6), (8) - have indicated that these types of behavior in Juvenile Delinquents are closely associated with broken and negligent homes. It is illuminating to find that the same relationships are already apparent at the nursery school age.

The definitions indicated that the irresponsible mother is liable to be inconsistent. This fact is interesting when we note in Table II that the child with

TABLE III

Relation of Preschool Behavior to Certain Factors Indicative of Tensions and of Security in the Home

Children's Behavior	Mother Quarrelsome	Mother Impatient	Mother Nervous	Mother Ill	Mother Fatigued	Mother Happy	Home Calm
Correlations Revealing a Rather Consistent Pattern							
Grabs toys	.65	.32	.38	.31	.26	.06	-.34
Jealous	.63	.37	.16	.16	.05	-.36	-.26
Refuses to share	.46	.24	.38	.05	.05	-.51	-.17
Rushes into danger	.45	.26	.26	-.10	-.05	-.16	-.35
Cries easily	.42	.46	.20	.28	.12	-.16	.13
Has fears	.42	.42	.21	.35	.05	-.30	.04
Refuses to comply	.37	.20	-.01	.22	.21	-.27	-.20
Grumbles	.32	.36	.17	.07	.16	-.07	-.28
Has nervous habits	.31	.36	.46	.50	.43	-.35	-.35
Refuses food	.30	.29	.24	.02	-.09	-.21	-.24
Wastes time	.30	.24	.45	.20	.12	-.10	-.03
Avoids risk	.27	.39	.23	-.10	.03	-.07	-.04
Hard to reason with	.26	.05	.04	.17	.29	-.38	-.29
Tense at rest	.24	.24	.25	.22	.04	-.59	-.02
Ignores requests	.20	.28	.29	.29	.24	-.25	-.28
Resists at rest	.20	.34	.29	.25	.35	-.39	-.09
Relates fanciful stories as real	.14	.28	.54	.23	.24	-.16	-.06
Leaves tasks incomplete	.12	.24	.27	.34	.27	.06	-.07
Shrinks from notice	.04	.31	-.05	.04	.21	-.25	-.04
Sulks	.01	-.18	.04	.28	.35	-.44	-.22
Correlations Revealing Negligible or Isolated Relationships							
Criticizes others	.40	.05	-.09	-.05	-.34	-.05	-.05
Attacks others	.37	.17	-.16	-.25	.09	-.38	-.16
Looks for praise	.29	-.13	.14	.20	.22	-.13	-.21
Seeks attention	.23	.14	.03	-.02	.19	-.24	-.23
Bosses others	.22	-.25	-.12	-.29	-.38	.16	.10
Has temper outbursts	.15	-.10	.20	.18	.17	-.16	-.16
Stays close to adult	.10	-.11	-.03	-.20	-.25	.20	.15
Asks unnecessary help	.00	.16	.17	.25	-.14	.00	-.09
Sucks thumb	-.08	-.12	.22	-.05	-.03	.05	-.13
Dawdles	-.08	-.15	.37	.37	.04	-.09	.12
Avoids play with others	-.11	-.34	.11	.17	.13	-.26	-.10
Number of Cases on which Correlations are Based							
Range	91 to 110	125 to 137	161 to 178	148 to 169	132 to 143	169 to 187	175 to 184
Median	110	137	178	169	143	187	184

the irresponsible mother tends to ignore requests and to be hard to reason with. Inconsistency on the part of the parent is the trait we should expect to lie behind such behavior.

III. The Calm, Happy Home Contrasted with Homes Which Display Signs of Tension

Two traits which seemed indicative of good home adjustment yielded enough material for statistical treatment: "Parent usually happy" and "home usually calm and secure." A tetrachoric correlation of .70 was obtained between the two.

Five traits were used as indications of possible tensions in the home: "mother fatigued," "mother ill," "mother nervous," "mother impatient," and "mother quarrelsome." The inter-correlations between these traits follow:

	Mother Fatigued	Mother Ill	Mother Nervous	Mother Impatient	Mother Quarrelsome
Mother fatigued	—	.78	.56	.34	.24
Mother ill	.78	—	.86	.73	.86
Mother nervous	.56	.86	—	.93	.93
Mother impatient	.34	.73	.93	—	
Mother quarrelsome	.24	.86	.93		—

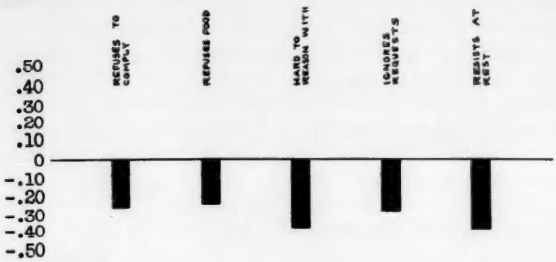
It will be seen, on the basis of the ratings, that "mother fatigued," "mother ill" and "mother nervous" belong to the same constellation much more than do the other traits. "Mother ill" and "mother nervous" bear the most consistently high relationships to the other traits and in this sense might be considered the best single indices in the group. Sufficient instances of positive occurrence were not available to justify a correlation between "mother quarrelsome" and "mother impatient."

Definitions for the traits discussed above are not presented in this section since the terms seem sufficiently clear as they stand.

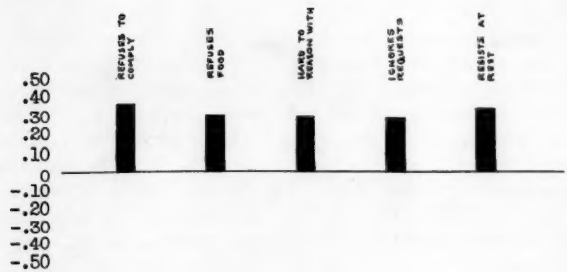
Table III contains the correlations found between the above seven traits and the children's pre-school behavior.[1] The order used in this table is based upon the size of the correlations between children's behavior and "mother quarrelsome." This latter set of data seemed to give the best picture of trends despite the inter-correlations discussed above for "mother ill" and "mother nervous." A set of correlations was obtained between children's behavior and a composite grouping of all signs of tension used in the study but these data added little to the picture already given and are consequently not presented.

The table reveals some very consistent trends in regard to negativistic reac-

[1] Four types of behavior which are included in the preceding tables (child "misrepresents facts," "breaks objects," "mistreats animals" and "secretly takes property of others") are omitted from Table III because the frequency distributions in the tetrachoric charts did not justify the analysis.



V. Co-operative Behavior in Relation to Well Adjusted Home



VI. Co-operative Behavior in Relation to Measures of Tension in the Home

Figures V and VI: Relations Found Between Co-operative Behavior and Measures of Home Adjustment. (On this chart the largest correlation obtained between the given behavior and any of the measures of good and poor home adjustment has been plotted).

tions. Children from homes which are happy and calm were less negativistic than children from the opposite type of homes. This is evident in the negative correlation between "mother happy" and "home calm" and (1) "child refuses to comply," (2) "child refuses food," (3) "child is hard to reason with," (4) "child ignores requests" and (5) "child resists at rest." In contrast, children from homes in which there are signs of tension (fatigue, illness, nervousness, impatience or quarrelling) showed definitely more negativistic reactions---in all of the five behavior patterns listed above---than did the other children. (Figures 5 and 6).

The same type of pattern noted above holds in the case of emotional disturbances. When homes were happy or calm there was less jealousy, fear, grumbling, nervousness and sulking on the part of the child. When homes showed any of the five signs of tension there was definitely more jealousy, fear, grumbling, nervousness and sulking and also more crying and more tenseness at rest. (Figures 7 and 8).

In the present set of data home tensions were not only related to uncooperative behavior and to emotional upsets, but also to personality difficulties, both of the aggressive ("rushes into danger" and "grabs toys") and withdrawing ("shrinks from notice," "avoids rest," "wastes time," "leaves tasks incomplete" and "tells fanciful stories") types. There is not the clear-cut pattern between aggressiveness and withdrawing reactions which the preceding analyses have yielded.

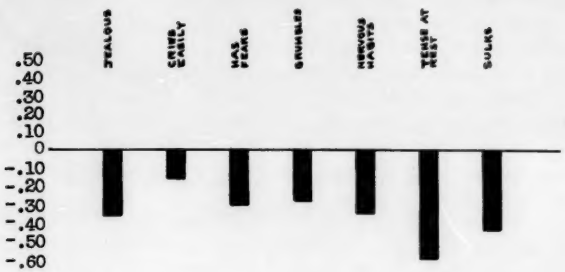
Table III contains a few isolated relationships which deserve mention. The apparent tendency for children to associate more with the adult in the well adjusted than the poorly adjusted home (indicated by positive correlations between "stays near adult" and "mother happy" and by negative correlations between "stays near adult" and "mother fatigued," "mother ill") is not surprising. It is interesting to note that children from calm, happy homes did not demand extra attention as did those whose mothers were quarrelsome and, to some extent, whose mothers were fatigued or ill. Here again it would seem that children from quarrelsome homes lacked a certain security which children from better adjusted homes possessed.

Children whose mothers were quarrelsome also showed considerable bossing, criticism of others and attacking. This behavior might be explained in terms of imitation. It is particularly outstanding since most of the other relationships between such behavior and home tensions were negative in nature.

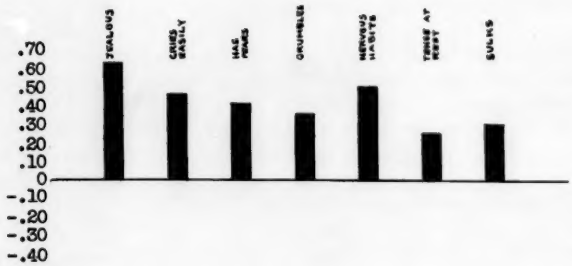
In the table also dawdling is related only to "mother nervous" and "mother ill." This is again a situation where imitation might play a part. "Asking help," with its positive relation to "mother ill," also conceivably fits into this picture.

IV. SHARING RESPONSIBILITIES AND PLAY INTERESTS IN THE HOME

For each home investigated in the study a judgment was obtained as to whether the child had a share in the family activities either in assisting parents, in having certain daily tasks of his own such as setting the table, or in taking



VII. Emotional Behavior in Relation to Well Adjusted Home



VIII. Emotional Behavior in Relation to Measures of Tension in the Home

Figures VII and VIII: Relations Found Between Emotional Behavior and Measures of Home Adjustment. (On this chart the largest correlation obtained between the given behavior and any of the measures of good and poor home adjustment has been plotted).

part in other family duties. Judgments were also obtained as to whether either or both parents shared in the child's play experiences such as reading to him, playing games with him, singing with him. As in the previous sections only the definite judgments of "never" or "usually" were used in the statistical comparisons. In this section, however, the groupings were based upon relations with either or both parents rather than upon relations with the mother alone.

The analysis has yielded some very similar and a few strikingly different correlations between preschool behavior and these two types of parent-child relationship.

Relations Common To Both

When parents and children shared either work or play experiences there was a tendency for children to have a better understanding of property rights and values. (Table IV). This is borne out in the negative correlations of the two types of parent-child relationship with "breaks objects," "grabs toys," "refuses to share," "secretly takes the property of others."

There was also a tendency for children who shared either work or play experiences with their parents to have better work habits. This is evidenced in the negative correlations between the two types of parent relationship and "leaves work incomplete" and wastes time at routines."

According to this table, children who shared either work or play with parents were also more cooperative than children who did not have such common experiences. (See the negative correlations between the two types of parent contact and "refuses to comply," "ignores requests.") This cooperative tendency is more marked when children and parents share play experiences than when they share home responsibilities. Negative correlations with "resists at rest" and "hard to reason with" were found only with the former.

Children who shared either work or play experiences with parents also seemed to have better relations with other children. They did not tend to avoid play with others or attack others. Again the relation seems more marked for "child shares play experiences" than for the other grouping (See the correlation with "bosses others" in this connection.)

Other types of behavior which show negative relations to both "child shares home responsibilities" and "child shares play experiences" and which are not discussed elsewhere in this section are "misrepresents facts" and "rushes into danger." No further generalization seems cogent here unless these types of behavior be considered signs of faulty perspective in which case children who share either work or play experiences with their parents could be said to maintain a better perspective or balance in their general reactions.

Relations Found Principally For "Child Shares Home Responsibilities".

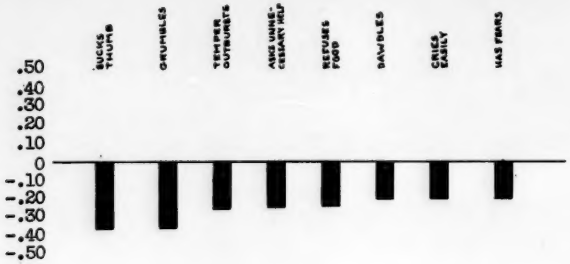
When children shared home responsibilities they did not tend to suck their thumbs, grumble, have temper outbursts,ask help unnecessarily,refuse food,dawdle,

TABLE IV

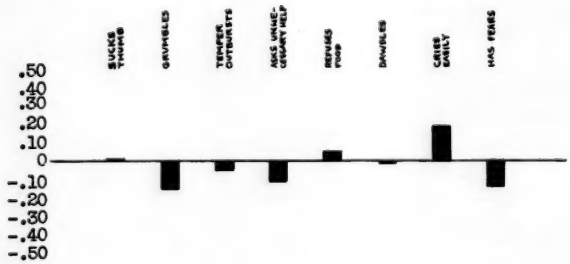
Relation of Preschool Behavior to (a) Sharing Home Responsibilities and (b) Sharing Play Experiences with Parents[1]

BEHAVIOR	Correlations	
	Child Shares Home Responsibilities	Child Shares Play Experiences
Relationships Common to Both		
Breaks objects	-.58	-.54
Grabs toys	-.55	-.50
Refuses to share	-.40	-.30
Has nervous habits	-.35	-.42
Takes property of others secretly	-.33	-.64
Sulks	-.33	-.27
Leaves work incomplete	-.31	-.32
Misrepresents facts	-.29	-.45
Rushes into danger	-.28	-.41
Ignores requests	-.24	-.31
Avoids play with others	-.24	-.25
Refuses to comply	-.23	-.29
Attacks others	-.20	-.28
Wastes time at routines	-.20	-.24
Relations Found Only For Child Shares Responsibilities		
Sucks thumb	-.37	.01
Grumbles	-.37	-.15
Has temper outbursts	-.26	-.05
Asks unnecessary help	-.25	-.12
Refuses food	-.24	.05
Dawdles	-.21	-.02
Cries easily	-.21	.18
Fears	-.21	-.14
Relations Found Only For Child Shares Play Experiences		
Shrinks from notice	-.17	-.45
Seeks attention by showing off	-.19	-.34
Looks for praise	.14	-.30
Bosses others	.18	-.30
Resists at rest	-.06	-.28
Hard to reason with	-.17	-.24
Avoids risk	-.08	-.23
Jealous	-.08	-.20
Tense at rest	-.04	-.20
Number of Cases on which Correlations are Based		
Range	193-206	206-217
Median	205	217

[1] Relationships with either or both parents are included in this category. No definite relations were found with: Goes to adult with criticism of others; Stays close to adult; Relates fanciful stories as real. Mistreats animals gave too one-sided a distribution to justify correlations.

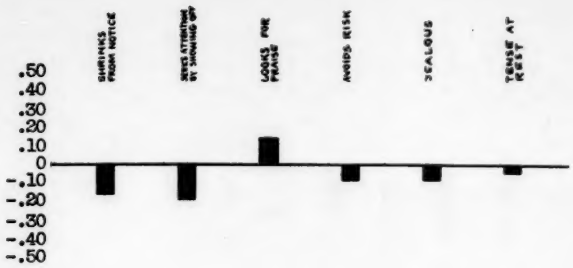


IX. Infantile Behavior in Relation to Sharing Home Responsibilities

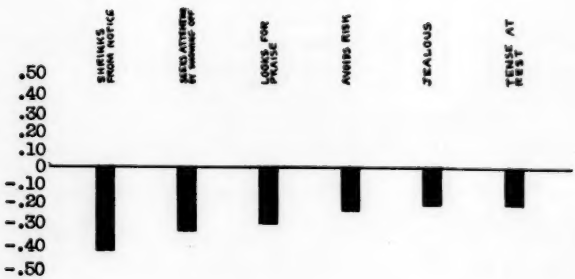


X. Infantile Behavior in Relation to Sharing Play Interests with Parents

Figures IX and X: Relations Found Between Infantile Behavior and Child's Sharing of Home Responsibilities and of Play Interests with Parents.



XI. Emotional Adjustments in Relation to Sharing Home Responsibilities



XII. Emotional Adjustments in Relation to Sharing Play Interests with Parents

Figures XI and XII: Relations Found Between Emotional Adjustments and Child's Sharing of Home Responsibilities and of Play Interests with Parents.

cry easily or have fears. It would seem from these relationships that sharing home responsibilities tends to help the child overcome infantile reactions and to make him more self-reliant. None of these relationships were found in cases where children shared play interests with their parents (Figures 9 and 10).

Relations Found Principally For "Child Shares Play Experiences".

Certain relationships were found between behavior and sharing play experiences which were not found between behavior and sharing home responsibilities. (Figures 11 and 12.) Children who shared play interests with their parents did not shrink from notice, seek attention by showing off, look for praise, avoid risk, show jealousy, show tenseness at rest. Three of these traits in particular ("seeks attention by showing off," "looks for praise," "jealous") are suggestive of emotional insecurity.

Not all behavior characteristic of emotional insecurity is limited in its relationships to this particular grouping. For example "has nervous habits" and "sulks" were found to be related to both classifications. However, in general, it would appear that the sharing of play experiences helps the child gain a feeling of security just as sharing home responsibilities seems to help him develop better habits of self-reliance and control.

The relationships found between "child shares play experiences with parents" and such behavior as "bosses others," "resists at rest" and "hard to reason with" have been discussed above and need no further discussion here.

GENERAL SUMMARY AND COMMENTS

This preliminary investigation has yielded some consistent and suggestive relationships between certain types of factors in the home and certain types of behavior in early childhood.

The study has suggested that children whose homes reflect over-attentiveness are liable to display infantile, withdrawing types of reaction. This finding is in substantial agreement with other evidence available in the field. Fitzsimmons (3), for instance, in her study of children of over-protective and rejective parents, also discovered the relationships indicated above. Adler gives one picture of the only child (11), the child who is pampered and babied, which is very similar to the picture given in Table I. A recent study by Stowell and the author (5) on over-attentiveness of parents in relation to work habits and social adjustments of children during the first six grades of school, also substantiates, to a surprising degree, the findings given above.

Previous studies also substantiate the present findings of positive relationships found between inadequate attention in the home and aggressive types of behavior. Mention has already been made of studies on Juvenile Delinquents (2, 6, 8) in which such behavior as misrepresenting facts, secretly taking property of others, mistreating animals, etc., seems to be closely associated with broken and otherwise negligent homes. Fitzsimmon's study (3) suggested that children whose parents are negligent are liable to show behavior difficulties of the aggressive

sort.

The study has given consistent evidence of the value of a calm, happy home in securing cooperative behavior and good emotional adjustments on the part of the child. Homes which reflected signs of tension in the form of frequent illness, fatigue, impatience, quarrelsomeness or nervousness made for uncooperative behavior and poor emotional adjustments.

The study has also revealed some useful techniques for futhering the child's development and for improving his adjustments. It has indicated that children can be helped in their development of self-reliance and in their consequent loss of infantile habits by having definite responsibilities in the home. It has also indicated that an opportunity to share play experiences with the parents is of real value in developing feelings of emotional security. A common recommendation in the nursery school, for parents who are faced with the jealousy of one child toward a newly arrived infant, is that the parents give the jealous child a definite time each day (perhaps 10 or 15 minutes) which is all his own. Such a special period which the child knows is his usually suffices to prevent jealousy over the extra attention which the infant necessarily requires during the remainder of the day. This technique is in complete accord with the research finding just reported.

The present investigation has also indicated that the constellation of behavior difficulties occurring in the school is in itself an important clue to the underlying factors. Asking for unnecessary help was, in the case of children with over-attentive parent, associated with staying near the adult and with various infantile reactions. In this case the behavior seems largely the result of lack of experience or of opportunities to "grow up." Asking unnecessary help was, in the case of children from homes which reflected inadequate attention, associated with seeking attention by showing off, seeking praise, and other forms of poor emotional adjustment. In this case the same behavior would not seem to be motivated by the actual need for physical assistance but to serve rather as an attention-getting device.

In closing it should be remembered that the present findings are offered only as suggestions of relationships which frequently, but not invariably occur. It is hoped that other studies which are being conducted along this line will contribute further understanding of these and similar relationships. A factor analysis which is also under way, on the behavior rating of the children used in the present investigation, should throw additional light on the data which have already been presented.

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PREFERENCES OF PRESCHOOL CHILDREN FOR SPECIFIC GEOMETRIC FIGURES

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Aesthetic theorists have always held that preference for a specific geometric figure is intrinsic to that figure itself. Thus Hogarth (2) in the 18th century, asserted that the key to beauty of visual form in two dimensions lies in the flattened S curve. Zeising (3) maintained that a given figure is beautiful only if the ratio of the separate parts is in the "Golden Section." The most modern exponent of this general principle of mathematical criteria for beauty is Birkhoff (1), who holds that "aesthetic" preference for one form among others is directly dependent on the relative simplicity, equilibrium, and vertical and rotational symmetry of that specific figure. He has devised a scale by means of which he assigns numerical "aesthetic values" to simple figures.

According to Birkhoff's scheme, positive values are assigned for the following points: a. Vertical symmetry; b. Rotational symmetry; c. Equilibrium; and d. Good relation between the vertical and the horizontal.

Penalties are exacted for: a. Too small distances between vertices and sides; b. Angles that are too near 0 or 180 degrees; c. Ambiguities; d. Unsupported re-entrant sides; e. Diversity of niches and directions; f. Lack of symmetry; and g. Complexity.

In order to test Birkhoff's general hypothesis, 30 figures that he had evaluated were cut out of black paper and mounted on white cards 2½ by 3 inches. They were then divided into 3 series of 10 cards each, the cards in the first series ranging in value from 1.5 to -.1; in the second series from 1.25 to -.11; and in the third series from 1.16 to -.17. Each series was then presented to 50 adults, who were asked to arrange the cards in order of perference.

Results from this preliminary survey emphasized the futility of the method. Each card in each series was given ratings from best to worst by some of the subjects. In some series there was more frequent preference for cards of high "aesthetic value" than for others. Reports from the subjects themselves indicated that, although the order of presentation had been uniform, juxtaposition of certain cards influenced final choices. Some subjects arranged the cards spontaneously by no fixed method, others according to elementary rules of what is considered "good" or "bad" art. A few chose by means of associations. Still others admitted they had no preferences but had only arranged the cards in rows to fulfill the requirements of the experiment.

In view of these results, it was decided to take only one of the three series and to test subjects of different age-levels in order to discover the methods by which choices for geometric figures may be made. It was also hoped that some data might be obtained to throw light on the development of adult standards and tastes.

[1] From The Child Institute, The Johns Hopkins University.

This report deals only with some preliminary work carried on with pre-school children. The specific problems of this part of the investigation were as follows:

1. To discover whether children of pre-school age are capable of making a consistent choice on the basis of either:

   a. A specific geometric figure presented in a series with other figure. Or

   b. A specific position in the presented series regardless of the specific card occupying that position.

2. To discover whether choice for card is easier in a series with actual pictures than in a series of geometric figures.

3. If either of these methods is found, to discover any possible relationship between method and chronological age.

4. Among those who choose consistently for card, to discover whether preferences are in conformity with adult standards of "aesthetic value."

5. To discover the relation between two methods of grouped choices of children and adults.

6. Among those who choose consistently for position, to discover which position is most consistently preferred.

7. To discover any possible relationship between consistency in making choices and time taken to make a choice.

APPARATUS AND PROCEDURE

The figures used in the experimental series were the same as those used in the first adult series. These cards were arranged in descending order of aesthetic value. Alternate cards were then taken to form the following 2 series of 5 cards each:

SERIES I		SERIES II	
Card	Aesthetic Value	Card	Aesthetic Value
A	1.50	B	1.00
C	.75	D	.58
E	.33	F	.25
G	.21	H	.12
I	.00	J	-.10

As before, the cards were made by cutting the figures out of black construction

paper, taking care to make the areas as nearly equal as was possible. These figures were then mounted on white paper 2½ by 3 inches, and on heavy gray pasteboard 3 1/4 by 3 7/8 inches, so that a margin of seventh-eighth of an inch was left between the lower edges of the white and gray cards.

A picture series, originally used to illustrate the procedure but later retained as a check on the figures, was made by pasting 5 black and white pictures on white and gray cards similar to those used for the 2 experimental series. The cards were as follows:

Picture 1 -- Two boys holding 8 puppies
Picture 2 -- A white terrier
Picture 3 -- A small car
Picture 4 -- A Boston Bull terrier
Picture 5 -- A horse and a girl in riding clothes

The apparatus used for presenting the two experimental series consisted of a black wooden box, 19½ inches wide, 6 inches deep and 20 inches tall. The front of the box was enclosed, but a screen could be raised to reveal an 8 inch opening at the lower front. Each of the two series was placed upright in a groove parallel with the back of the box. The first groove, 5 inches from the back, was on a movable frame so that, by means of an outside string, it could instantly be raised above the opening to reveal the second series of cards standing in a stationary groove 4 inches from the back of the box. The movable frame was backed with black cardboard 4 inches high so that removal of a card in the first series, did not instantly reveal one of the second series.

Uniform illumination in the entire box was obtained by inserting a ground glass panel in the top of the box. This diffused the light from two 100 watt lamps built in immediately above the glass. The "mail box" was a silver card board box, 7 3/4 inches wide, 7 3/4 inches deep and 9 3/4 inches tall, with a slot 5 by 5/8 inches in the lid.

The presentation box was placed on a low table so that the cards would be at approximately the eye level of the child seated before it. The "mail box" was placed on a low stool to the right of the child. The Experimenter sat back of the child and somewhat to the right, so that she could raise the screen and the frame and at the same time make records without attracting too much attention from the child.

The first series was arranged on the movable frame and the second in the stationary groove. The frame was then lowered into position and the screen was closed. The Picture Series was arranged on the outside of the box placed upright against the closed screen. The pictures were then covered with black card board until the child was seated before the apparatus. In order to secure maximum benefit from the controlled lighting effects window shades in the experimental room were closed.

The arrangement of the cards on all three series varied on each of the five trials so that at the end of the experiment each card had occupied each of the

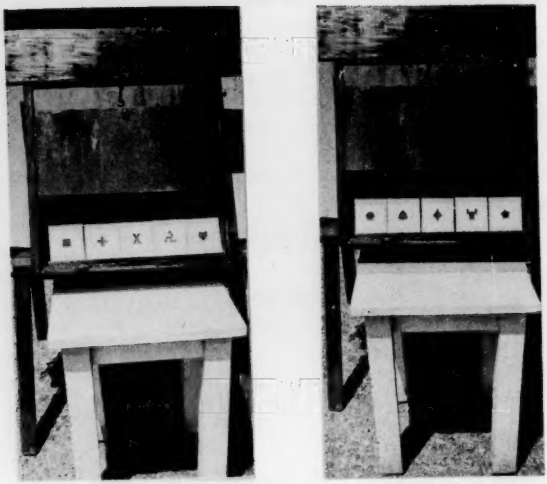

Figure 1. Illustration of figures presented in the two experimental series.

five possible positions. Arrangements, reading from the child's left, were as follows:

TRIAL	PICTURE SERIES	SERIES I	SERIES II
1	1, 2, 3, 4, 5,	A, C, E, G, I	B, D, F, H, J
2	2, 4, 1, 5, 3,	C, G, A, I, E	D, H, B, J, F
3	3, 5, 2, 1, 4,	E, I, C, A, G	F, J, D, B, H
4	4, 3, 5, 2, 1,	G, E, I, C, A	H, F, J, D, B
5	5, 1, 4, 3, 2,	I, A, G, E, C	J, B, H, F, D

When the child had been seated before the box, the screen was removed from the Picture Series and the following instructions were given:

"See these pictures?" (pointing to series) "And see this box?" (pointing to mailbox and outlining slot) "It's like a mail box, isn't it? Take the prettiest picture and mail it in the mail box" (Again pointing to series and then to mail box) "Ready. Take the one you like best."

As soon as the child had mailed a card, the remaining four pictures were re-

moved and the Experimenter said:

"Now see the big black box?" (pointing to apparatus) "It has some more pictures in it. When I open the box take the prettiest picture out and mail it in the mail box. Ready. Take the one you like best."

The screen was then raised until the child had taken a card in his hand. Then the screen was dropped and the movable frame raised so that the second series would be exposed as soon as the box was opened.

"Now I'll open the box again. Take the prettiest picture out and mail it in the mail box. Ready. Take the one you like best."

The screen was then again raised until a card had been chosen.

Time was taken on the two experimental series with a stop watch. This was recorded from the moment the screen was raised to the time a child touched a card with the obvious intention of mailing it. A child rarely changed his selection. If two cards were touched the first was recorded as the one chosen, while note was made of the other. Since the Picture Series was used to illustrate procedure and was revealed while instructions were being given no record of time was kept. Verbal responses were recorded for all three series. The three series were always presented in one sitting. No child received more than one complete trial a day.

Subjects were 22 children attending the Child Institute at the Johns Hopkins University. Their ages ranged from 31 to 59 months:

Age in Months	Boys	Girls
30-35	1	2
36-41	5	3
42-47	-	2
48-53	4	2
54-59	-	-
60-65	1	-
66-71	1	1
	12	10

RESULTS

1. Individual Consistency.

   a. For cards. Since a total of five trials was given on each series, three choices of the same card was taken as the criterion for a consistent preference due to something other than a chance factor. Ten children met this criterion on the Picture Series, 8 on Experimental Series I and 6 on Experimental Series II.

Some of the children chose the same card four or five times. These results

are summarized in the following table:

Series	Number of consistent choices 3	4	5	Total number consistent
Picture Series	3	4	3	10
Series I	5	2	1	8
Series II	3	3	0	6

Three children were consistent on all series; five were consistent on both of the Experimental Series. From both the standpoint of total number of children choosing consistently on each series, and the number of children choosing the same card on more than 3 trials, it seems that these children had slightly more decided preferences for the pictures than for the geometric figures. This difference was not very large.

b. For position. The same criterion of three choices as a basis of consistent preference was used in analyzing results according to choice for specific position in the series. Seven children chose for position in the Picture Series, and 13 chose for position on each of the two Experimental Series:

Series	Number of consistent choices 3	4	5	Total number of consistent children
Picture series	6	0	1	7
Series I	5	6	2	13
Series II	6	3	4	13

Three children chose for position consistently on all three series; twelve chose consistently on the two Experimental Series. There was far less choice for position in the Picture Series than in the two Experimental Series. This holds true both for total number of children choosing consistently for position and for number of children making more than 3 choices.

2. Relation between method used for making choices and chronological age.

a. Chronological age and choice for card. The average age in months of children making 3, 4, or 5 consistent choices on each of the series was as follows:

Series	Number of consistent choices 3	4	5	Average age of all choosing consistently
Picture Series	45.5	-	36.0	44.3
Series I	42.0	39.2	37.0	39.8
Series II	40.5	45.0	39.0	41.1

Choice for position thus occurs more frequently with the figures than with the

pictures. There is a steady decrease in choice for position with increase in chronological age.

3. Group choices for individual cards.

The total number of times each card was chosen and the ranking it attained were as follows:

	Picture Series					Series I					Series II				
Card	1	2	3	4	5	A	C	E	G	I	B	D	F	H	J
Times chosen	13	32	31	14	20	22	35	12	27	14	18	17	26	28	21
Ranking	5	1	2	4	3	3	1	5	2	4	4	5	2	1	3

These choices seem to bear no significant relation to theoretical standards of "aesthetic value."

The procedure used with 50 adults was different, for all 10 cards were presented in one series and the subjects were asked to rank all cards in order of preference rather than to pick the favorite. Nevertheless, it might be interesting to compare their final rankings with those of the children.

Adult ranking for all 10 cards -- Method of average rank.

Card	A	C	E	G	I	B	D	F	H	J
Rank	5	3	6	1	8	4	10	2	7	8

It seems that both adults and children tend to rate cards G, C and F relatively high.

4. Group Choices for position.

The total number of times cards in each position were chosen and the ranking for each position are summarized below.

	Picture Series					Series I					Series II				
Position	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Times chosen	25	16	20	24	25	15	6	43	23	26	8	20	38	13	36
Ranking	1	5	4	3	1	4	5	1	3	2	5	3	1	4	2

Choice for position is not well shown in the Picture Series. In the other two series, the middle and the extremes in position were definitely preferred.

5. Cards preferred by those who chose consistently.

It is interesting to note that those children who chose consistently for cards tended to agree on the particular card they preferred:

Number of Cards Chosen Consistently.

Picture Series	Card	1	2	3	4	5
Times chosen		0	4	4	0	2
Series I	Card	A	C	E	G	I
Times chosen		2	4	0	1	1
Series II	Card	B	D	F	H	J
Times chosen		1	2	1	2	0

6. Positions preferred by those who chose consistently for position.

Number Consistent Preferences.

Position	1	2	3	4	5
Picture Series	2	1	1	1	2
Series I	1	0	7	0	5
Series II	0	1	6	0	6

There was no position that was consistently preferred on the picture series. Marked preference was given to the middle and last positions on both experimental series. Of the 12 children who chose for position on both Series I and II, 10 children chose the same position twice.

7. Relation between method of choice and time.

The average time needed for making a choice among those who chose for pictures was 52.4 seconds on Series I and 37.2 seconds on Series II. Those who chose for position averaged 98.8 seconds on the first series, and 47.7 on the second.

Choice for position therefore, seemed to require a longer time although the difference does not seem to be very reliable. In both cases, more time was required for Series I than for Series II.

SUMMARY AND CONCLUSIONS

Twenty-two nursery school children were shown three sets of five cards. One series consisted of black and white pictures, the other two series of geometric figures cut out of black construction paper. They were asked to pick the card they preferred out of each series. Each set of cards was presented five times, so that by the end of the experiment each of the cards had once occupied all of the five possible positions in the series.

Although subjects were too few to permit generalizations, the following conclusions may be drawn:

Among 22 pre-school children the majority showed themselves capable of choosing cards on a basis better than chance. They chose either on the basis of the cards presented or on the basis of the position a card might occupy in a series.

Pictures were chosen more frequently for card and less frequently for position than were geometric figures.

Ability to choose by card increased steadily with chronological age; choice for position decreased with chronological age.

There was no relation between cards chosen most frequently and theoretical standards of aesthetic value.

As nearly as can be determined by the use of different procedures adults and children tend to prefer the same geometric forms.

Children who choose according to specific cards tend to agree on the cards they prefer.

Children who choose according to position tend to prefer the middle and the last positions.

Children who choose for card on one experimental series tend to do so on the other. The same holds true for choice of position. In the latter case they also tend to choose the same position on both series.

Choice for position seems to require a longer time than choice for card. Overlapping of time is so great, however, that the difference does not seem to be reliable.

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